SCIENTIFIC AMERICAN

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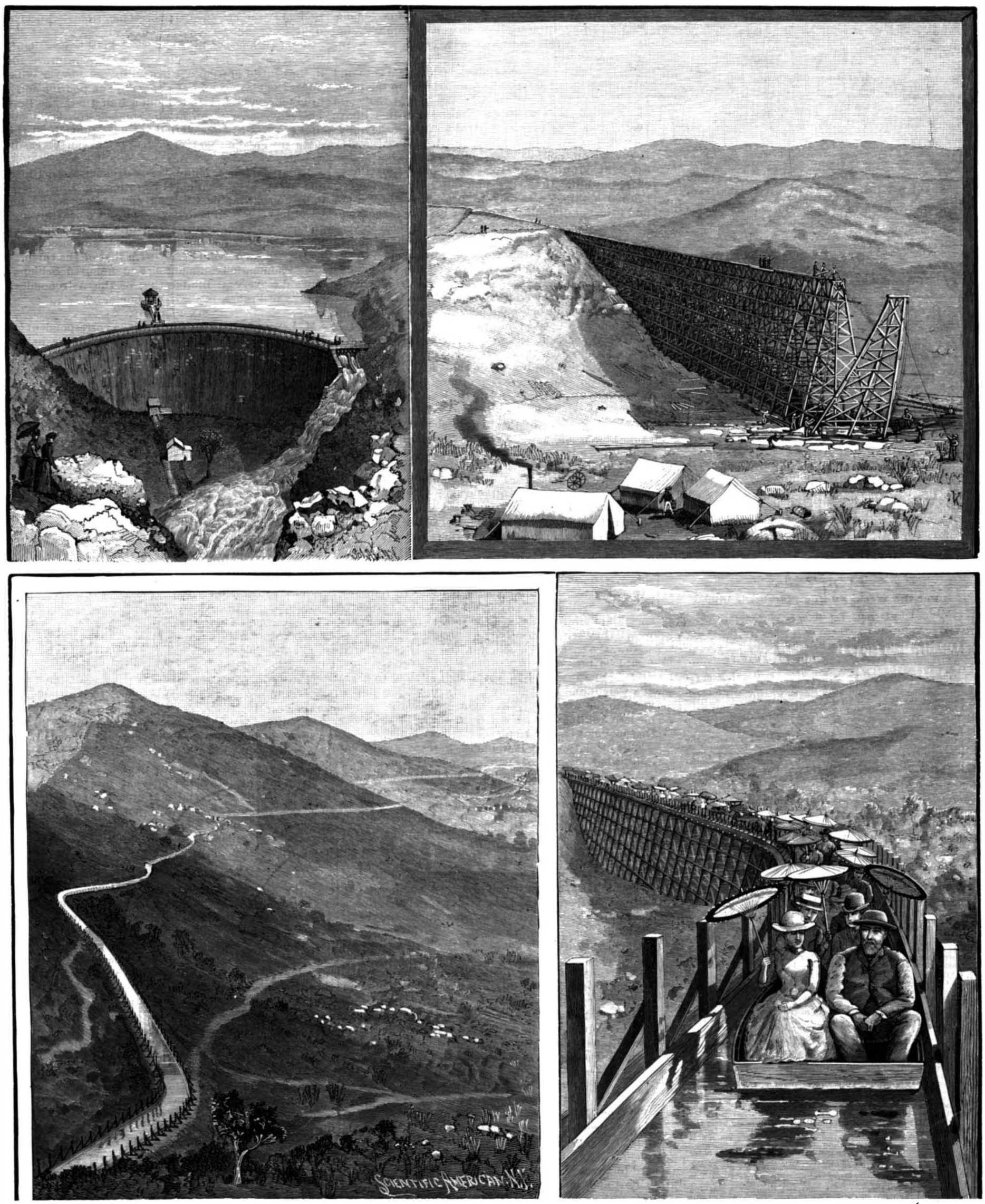

1. Sweet Water Dam. 2. Constructing Sweet Water trestle—height, 81 feet; length, 1,264 feet. 3. General view of flume in eastern canyon. 4. Floating down Los Coches trestle—height, 65 feet; length, 1,774 feet.

CONSTRUCTING FLUMES FOR PURPOSES OF IRRIGATION AND WATER SUPPLY IN SOUTHERN CALIFORNIA.—[See page 167.]

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 741.

For the Week Ending March 15, 1890.

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THE MONITOR AS A BATTLE SHIP.

As to high speed, of course, that is not to be expected of a monitor. It was promised for the modern fighting ship, but how much has been realized? Sixteen knots with forced draught, it is, perhaps, not unfair to say, is good time for the best of them, if we except a few, and these mostly unarmored or protected cruisers. Now, forced draught has come to be regarded as a recourse of such doubtful expediency that there is reason to believe it will in the not distant future go out of use. Without it the speed of the average armored ship is much below 16 knots an hour. If we except speed and the comfort of the crew, the monitor would seem to be a more effective engine of war than the average modern ship. It has greater buoyancy, and presents but a minimum of target.

Analyzing its good and bad qualities, the London *Engineer* quotes the testimony given by Admiral Shufeldt, U. S. N., before the Senate committee, to the following effect:

"After an experience of a good many years at sea, I feel that I ought to say, first, in regard to the monitors, that I think they can go to any part of the world and fight at sea as well as any battle ship that I have ever met or have ever seen. First, because they have very much more stability. Of course, if there is a very heavy sea on, neither the monitor nor the battle ship can fight. If they can, it will be the first time I have ever known it. In the case of a ship rolling 40 degrees, the battle ship Mr. Tracy proposes probably would find it just as difficult to work her battery as the monitor, whereas the monitor will be rolling only a very few degrees, and would have very much more stability on that account. I think the monitor can go to sea anywhere, and I do not see any reason why you cannot give her a coal endurance. I know that the Miantonomoh has not the coal endurance, and I know the Puritan has not the coal endurance, but in building new ships I do not see why you cannot give them the coal endurance. I believe that the American system, which is the monitor system, is the best in the world. You can improve upon the monitor system as much as you like. There is another point in regard to the monitor, that having a low freeboard and only two turrets, she can approach an enemy with much greater impunity than one of the high-freeboard ships. She cannot be seen in a dark night. She could approach almost like a torpedo boat on our coast. Supposing an enemy to be anchored upon the coast, two or three monitors could attack her, and they might easily avoid observation, because nothing would be above water except the two turrets."

Then it quotes Admiral Rodgers, who was in command of a monitor in a heavy storm:

"The sea ran 30 feet high, but the behavior of the vessel was easy, buoyant, and indicative of thorough safety. Her movements filled me with admiration. I saw everything to admire, and nothing to improve. The waves rolled furiously across the deck. Instead of spending their force against the side, as in an ordinary vessel, they swept harmlessly by."

Now, the turret of a monitor, the only target that would be presented to the fire of an adversary, may, because of the great buoyant body under it, be made of a weight and thickness which is practically impervious to the assault of heavy guns, while the largest modern fighting ship cannot float a weight of armor that may not readily be pierced at short range.

This being the case, it would seem reasonable to inquire what advantage it possesses over the monitor as an offensive war engine to make up for the enormous excess of cost? It can run away from the monitor. True. But it cannot hope to catch the unarmored, or even the protected, cruiser, while the latter, if it can be made to realize the promise of its designing, ought to be able to overhaul the most speedy craft of the mercantile fleet.

From this, it would seem that the ponderous and costly fighting ship, of which so many examples are to be found in European fleets, is but a nondescript, a giant only formidable in the warlike appearance of its fashioning.

The newest design is not always the best, a fact that has found ample corroboration in warship construction. It is fortunate, therefore, considering the qualities the monitor type is known to possess, and the doubt yet existing as to its possibilities, that it is to have further development and test; some of the best of the old ones, notably the Puritan and Terror, being now almost rehabilitated, and the navy department disposed to further investigation in the same direction.

THE CELESTIAL WORLD.

THE ROTATION OF MERCURY.

Schiaparelli, the eagle-eyed astronomer of Milan, who has aroused great interest in the double canals and the changes taking place on the surface of Mars, announces something new and passing strange in regard to Mercury. He finds convincing proof that the swiftest and smallest of the planets in his revolution around the sun always presents the same face to the great luminary, exactly as the moon makes her circuit around the earth.

Schiaparelli commenced his observations in 1882, making them during the day, in full sunlight, and using a telescope with an 8 inch objective. He has obtained 150 drawings of Mercury, and the markings or linear spots visible on his disk remain always the same, not having changed during the seven years of close scrutiny of one of the most skillful and experienced astronomers in the world.

He therefore concludes that the rotation of Mercury on his axis is completed in eighty-eight days, the time of his revolution around the sun. One hemisphere of the planet is constantly illuminated by the sun, the other is constantly in darkness. The eccentricity of Mercury's orbit is very great, consequently the libration in longitude is correspondingly great. A portion of the planet's surface along the circle of illumination must therefore pass in succession from darkness to light.

What curious conditions, viewed in this new light, prevail on Mercury! An enormous temperature reigns in the central portion of the hemisphere forever lying under the blazing light of a noonday sun pouring forth from four and a half to ten and a half times the heat received from our sun at the summer solstice, a sun that never sets, while eternal darkness prevails on the other side, and a cold more intense than can be easily conceived.

Schiaparelli has found two astronomers, Perrotin and Terby, to confirm his observations on Mars. It is to be hoped that he will find equal confirmation for his observations on Mercury. They are more startling, and overturn more entirely all preconceived ideas of the axial rotation of the little planet, supposed for a century to correspond nearly with that of the earth.

M. Flammarion announced and indorsed Schiaparelli's discovery at the meeting of the Astronomical Society of France, in Paris, on January 8.

SIX PLANETS.

M. Leveque, at Lyon-Monplaisir, a correspondent of *L'Astronomie*, records the observation with the naked eye of six planets at the same time, on November 1 of last year, at 5 h. 30 m. A. M. The planets were: Venus in Vigo, Mercury near Venus, Mars and Saturn in Leo, Vesta in Cancer, and Uranus in Virgo. The same sharp-sighted observer follows the movement of Venus with the naked eye during the day.

THE LAST DECADE OF THE NINETEENTH CENTURY.

Several important and interesting phenomena will occur in the last decade of the nineteenth century. Mars will be in opposition in 1892, under conditions more favorable for observation than have occurred for fifteen years, when, in 1877, his two satellites were discovered. Jupiter will be in perihelion in 1892, July 24, when he is about 42,000,000 miles nearer the earth than when in aphelion. Mercury will make a transit on the sun's disk in 1894, November 10, when the telescope will reveal his presence as a small black spot on the sun's bright face. A grand shower of November meteors will take place in 1899, when stars will fall from the sky like flakes of snow. A total eclipse of the sun will occur in 1900, May 27, that will be visible from Virginia to Louisiana.

ECLIPSES IN FUTURE YEARS.

The twentieth century includes three years in which seven eclipses—the largest number possible—take place. In the year 1917 there are seven eclipses. In the year 1935 there are seven eclipses, five of them solar eclipses. In the year 1985 there are seven eclipses, three of them being total eclipses of the moon.

THE SUN SPOT CYCLE.

The minimum of solar spots has probably passed. From October 4 to December 11 of last year, a period of sixty-eight days, not a single spot was visible on the sun's face. A small spot appeared on December 12, near the western border, that disappeared on the next day. An increase in solar activity may soon be expected.

Protection of Fruit Trees.

The Massachusetts Agricultural College, located at Amherst, issues bulletins occasionally, giving results of their experiments, which are useful to the farmer and all persons interested in horticulture. In the last issue of the bulletin, we find the following directions for ridding fruit orchards of pests which are sometimes very destructive:

In addition to the simple mixture of lime, cement, and Paris green wash, we have found, if the above be mixed with skim milk, it adheres better than if mixed with water, in some cases adhering firmly for six months or more.

Portland cement adheres more firmly than the Rosendale, and is more satisfactory when not mixed with milk than the latter.

Several reports have come to us of young trees having been injured by woodchucks during the summer, and in one case we can report that out of more than one thousand trees treated with cement, milk, and Paris green, not one was injured during the past summer, while many not painted were seriously injured.

The amount of Paris green used was one tablespoonful to each two-gallon pail full of paint, mixed so as to easily apply with a paint brush.

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THE MANUFACTURE AND USES OF ALUMINUM.

BY H. C. HOVEY.

The formal opening of the great works of the Aluminum Brass and Bronze Company, at Bridgeport, Conn., which will be described in a succeeding article, makes it desirable, as a preliminary, that we state a few facts about the unalloyed metal itself. Quite learned men have indulged in wild talk about the metal, which is more widely distributed over the globe than any other, being known to exist in 200 different minerals, including all granites and common clays.

Wm. Anderson, C.E., in a recent address before a scientific society in England, stated that aluminum was discovered as a distinct metal by Marggraff 136 years ago; whereas the latter only showed that alumina was a distinct earth, the discovery of its metallic base being reserved for Woehler, who separated it as such in 1828. If scientific men thus err, what may be looked for from the ordinary public? A recent order from a prominent manufacturer calls for a quantity of "illuminum." At a late club meeting in a large New England city a capitalist inquired as to the precise object of the "alumni factory" just built at Bridgeport; whereupon a Yale graduate gravely assured him that the best factory of that sort was located at New Haven. The money king innocently, but aptly, replied that "if the Bridgeport article was no better than that produced at New Haven, he thought it would hardly find a market." He had been misled by the common mispronunciation of "alumnium."

The problem has been to extract the metal cheaply, and chemists of every land have labored for a solution. Oerstedt suggested a process of obtaining aluminum by treating the chloride with an alkali metal. Adopted by Woehler, and modified by Deville, the process was "a reduction of the double chloride of aluminum and sodium, by means of metallic sodium, in the presence of cryolite." It was thus that Deville was able to show at the Paris exhibition in 1855, as the greatest of modern chemical wonders, a bar of what he styled "silver-white metal made from clay." He sold aluminum first at $15 an ounce, but in 1857 he reduced the price to $2 an ounce. Improvements cheapened the product still further, so that Colonel Frishmuth, who cast the tip of the Washington monument, in 1884, was able to furnish the metal in bars at $15 a pound. In that year, however, he made only 1,800 ounces, and the entire import was but 590 pounds.

Prior to 1887, the entire amount manufactured annually was but 10,000 pounds, and it sold that year at $10 a pound. To get even this small amount required the annual manufacture of 100,000 pounds of the double chloride and 40,000 pounds of sodium. To cheapen these two preliminary processes was essential to the cheap production of aluminum.

Hence the importance of the process patented by Mr. Hamilton Y. Castner, June 1, 1886, which was the first patent ever granted for an aluminum process in the United States. Its special feature was a cheap way of getting sodium. He reduced and distilled it in large iron crucibles, raised automatically through apertures in the bottom of the furnace, where they remain till the reduction is completed and the sodium distilled. Through tubes in stationary covers the distilled metal passes to condensers, where it is solidified. When the process is completed, the crucible is lowered and a new one with a fresh charge is substituted and raised into the furnace. The residues are carbonate of soda and metallic iron, both of which can again be utilized. The process is as simple as it is ingenious, and the temperature required is very moderate, the sodium distilling as easily as zinc. One charge requires about an hour, and a battery of four furnaces can yield a ton of sodium a day. The metal is kept from oxidation by a covering of mineral oil till used.

The Deville-Castner process takes the double chloride finely divided and mixed with thin slices of sodium, and empties the mixing cylinder on the hearth of a reverberatory furnace, where the mass quickly melts, and a reaction takes place that finally liberates a silvery stream of molten aluminum that is drawn out from below, while the melted slag runs off from above. The first run is purest and contains about three-fourths of the charge. The remainder is scraped off from the hearth, or found entangled with the slag, from which it has to be separated. The aluminum is finally remelted in plumbago crucibles, and cast into ingots, bars, or plates. The *Journal of the Society of Arts*, from whose very extended account the foregoing is abridged, adds that, day by day, as the manufacture progresses, improvements are made which either enhance the economy of production or the purity of the product, and speaks in the highest praise of the skill, energy, and perseverance of Mr. Castner and his assistants, by whom, more than any others, aluminum has been brought into the market on commercially practicable terms, and in a condition of almost perfect purity.

Grabau's process may be briefly described. Powdered cryolite put into a solution of the sulphate of aluminum gives by reaction the fluoride of aluminum, which is then heated till ready to evaporate. The heated fluoride is pulverized and thrown upon melted sodium contained in a vessel lined with cryolite. The heat generated by the violent reaction melts the aluminum as well as the cryolite; and the molten mass being poured out, the pure aluminum settles at the bottom, while the cryolite is at the top. The main advantage of this method over the Castner process is that it goes on at a lower temperature and is extremely simple.

Numerous other processes are described by Richards in his exhaustive work on the subject, *e. g.*, reduction by cyanogen, by hydrogen, by carbureted hydrogen, by carbon and carbon-dioxide, concerning all of which Dr. T. Sterry Hunt remarks that "there has been no pure aluminum made commercially save from the chloride by the use of sodium." Webster is the chief manufacturer in England, on his own patents; and large works have been erected in France on Bunsen and Deville's process by electrolysis.

But, after all, the only true rival of the Castner-Deville process seems to be the Hall process, on patents of Charles M. Hall, and carried on by the Pittsburg Reduction Company, who are now selling pure aluminum at a rate cheaper than nickel; and tons of metal are rolled by the Scoville Manufacturing Company, of Waterbury, into sheets, bars, rods, and tubing at a price less than German silver. Briefly the Hall process is this: A flux being discovered that, at a moderate temperature, takes the aluminum ore into solution, and that is of lighter specific gravity, and that also is unaffected by the passage of an electric current, he fills a series of carbon-lined steel pots with the flux, which is kept in a melted condition. Carbon electrodes are plunged into these baths, through which passes the electrical current, which acts to send the aluminum to the sides and bottom of each pot. The baths are constantly replenished with ore, and the process thus goes on for an indefinite period, night and day, at small cost, and demanding but little attention.

Aluminum, whether pure or in combination, deserves to rank with the noble metals—although in certain forms it makes the basis of our common clay, every cubic yard of which is said to contain 800 pounds of the metal; in other forms it is massed in mountains; and in others still it shines among the most precious stones, entering into the composition of the ruby, sapphire, topaz, garnet, lapis-lazuli, and tourmaline.

Cryolite, found in Greenland, and beauxite, first found at Beaux in France, but since in Austria, Ireland and elsewhere, are the ores relied on for the manufacture of aluminum. Cryolite is a snow-white mineral, though often tinged red or yellow by impurities. Beauxite is a hard white clay occurring in beds many feet thick. Corundum, found in Georgia, is the material relied on in America especially for making the alloys. It varies from dull blue to black, and exists in massive form, as well as in crystals. The cost at the factory of these different minerals varies from $60 to $140 a ton.

The properties of aluminum are now generally known. Its color is white delicately tinged with blue, and it resembles silver more than any other metal. It takes a brilliant polish, and may be rolled or forged as easily as gold or silver, and may be beaten into very thin leaves. It can be pressed or stamped into all sorts of shapes, or drawn into very fine wire. Its elasticity and tenacity are about the same as virgin silver, but change greatly under the hammer. It is said to resist the graving tool till properly varnished, when it may be cut like copper. Its sonorousness is very curious. Cast in bell form its sound is sharp, and not prolonged; but struck as a bar it is remarkably sweet, pure, and resonant. Its sound is resolved into two tones related to each other as are D and A. It might not work well in the form of tubular wind instruments; but fine effects might be had from a series of chromatic bars. I do not know that the experiment has been tried.

In estimating the relative cost of aluminum as compared with other metals, we must take its specific gravity into the account. A bar of aluminum weighing one pound would be about four times as large as a similar bar of silver, brass, bronze, tin or iron. Hence, at an equal price, aluminum would be four times as cheap as silver. But as it now costs by weight only one-eighth as much, it must be relatively about 32 times as cheap. In other words, the purchaser would find it economical to use aluminum in preference to silver for everything to which it is adapted. As a conductor of electricity it equals silver, and is eight times better than iron, and as a conductor of heat it excels any other metal known. Neither air nor water, hot or cold, affects it, and it resists all acids except hydrochloric. It slowly yields to a mixture of salt and vinegar, with a result as harmless as clay itself. It does not seem to be affected by saliva, perspiration, or other animal agents. Hydrogen, nitrogen, sulphur, and carbon do not affect it, but it is rapidly attacked by chlorine, fluorine, iodine, and bromine. From the above observation aluminum does not seem to have an intimate analogy with any other known metal, though Richards and Woehler place it near to silicon and boron in the carbon series.

Aluminum melts slowly, at about 700 degrees C., (1292 degrees Fah.), without a flux, and in an ordinary uncovered earthen crucible lined with carbon. The pieces of divided metal are first dipped in benzine to clean them, and if necessary are treated with nitric acid, and then put in the crucible little by little.

A cinder remains at the bottom of the crucible. The molten metal may be cast either in metallic moulds or in very dry porous sand with numerous vents. Deville prefers a plumbago crucible without a lid, and exposes the red hot metal for a long time to the open air, to allow the exhalation of the acid fumes, after which the surface is skimmed without loss of metal. It is then cast into ingots. To get perfectly clean results this process is repeated three or four times. The pure metal thus obtained improves in color with using, while what is less pure tarnishes in time, though perhaps equally brilliant on first casting.

The Aluminum Company, with offices at 115 Cannon Street, London, and works at Oldbury, near Birmingham, issued a price list, November 1, 1889, from which we quote aluminum, 99 and qr. to 99 and 3 qr. per cent. purity guaranteed, 15 shillings per pound; 98 to 99, ditto; 95 to 96, 12 shillings a pound.

The first article manufactured from pure aluminum was a rattle for the young Prince Imperial of France, in 1856, the sonorousness of which was much admired. It was next made into jewelry, medals, and inlaid work. Its extreme lightness led to its being used for sextants, eye glasses, opera glasses, and the tubes of telescopes. It has been found useful for the beams of balances, for delicate weights, and in the form of fine wire for embroidery. Culinary articles made from it were to be seen at the London exhibition in 1862, for which it seemed admirably adapted on account of its lightness and immunity from corrosion.

Experiments have been rapidly multiplied of late, under the encouragement given by reason of the increased cheapness of the metal, and a promising field is surely opening for its employment for many ornamental and useful purposes. The processes of soldering, welding, veneering, gilding, and silvering aluminum are minutely described in Richards' work on the subject.

The imagination has been allowed free play as to the manifold advantages of a metal at once so light and so strong. As a single specimen of the poetical flights of which scientific men are sometimes capable, I quote the prediction of one of the most eminent savants of America that "Some day aluminum will revolutionize the world. It will be used in the construction of houses, thus superseding wood, stone, and brick. It will take the place of iron in ship building. The ocean steamer of to-day will be but a canal boat compared with the aluminum ship that will fly as a bird over the waves." To all of which we can only say —possibly!

The aluminum industry is on a firm footing, both in Europe and America. There have sprung up two distinct lines of manufacture; the one a chemical process, and the other strictly metallurgical. The former produces pure aluminum, and continues to be a complicated process demanding skill and patience. The latter produces only the alloys of aluminum, and has been made extremely simple by certain methods to be described in a future communication.

Puget Sound Lumber Industry.

The Port Blakely Mill is the largest mill on Puget Sound. It can cut logs of any length up to 130 ft., and has a capacity of 300,000 ft. every ten hours. The mill is a modern one, having been rebuilt after the fire of 1888, and has more power in proportion to its size than any other mill on the coast. It is furnished with two double circulars with sixty inch saws on both upper and lower arbors, two pony rotaries or resaws, and a large gang, besides the smaller machinery. This mill ships nearly all of its product by water to California and foreign ports. During the twelve months ending November 30, 1889, they shipped eighty-eight cargoes of lumber, of which fifty-five were sent to foreign ports, chiefly to Australia, and thirty-three to domestic ports, chiefly to California, twenty-seven going to San Francisco, and only one to an Atlantic port —Boston—and that laden chiefly with spars and shingles. The total amount of lumber shipped was 49,450,310 ft., board measure. In addition there were 9,444,689 lath, 635,136 pickets, 943,250 shingles, 177 spars containing 181,363 ft., and 3,842 piles containing 239,961 lineal ft. Besides this there was a large quantity of lumber sent over to Seattle from this mill after the fire, amounting to between twenty and thirty million, with other local sales.—*Pacific Lumberman.*

County Licenses.

An act passed by the Pennsylvania legislature in 1861 requires hucksters from outside of a county to pay a license of $20 and hucksters living in the county to pay a license of $10, imposing penalties for failure to pay these licenses. Judge Endlich, in a decision just rendered at Reading, held the law unconstitutional, on the ground that it was a law regulating commerce, such as Congress alone had power to pass, and also for the reason that it discriminated between residents and non-residents.

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Smokeless Powder.

Sir Frederick Abel, a high authority on the subject, lately read a paper at the Royal Institution.

Four years ago smokeless powder of extraordinary power was said to have been introduced with the Lebel rifle in France. It has since transpired, however, that several successive experimental compositions were tried with this rifle. Guncotton pure and simple was tried by Sir F. Abel for small-arm cartridges for some years with marked, but not uniform, success. Great advances were made, however, on Von Lenk's achievements with guncotton, and the adoption of guncotton as an explosive was then achieved by Sir F. Abel, and, though not as a military propellant, it has been used with great success in sporting cartridges. Colonel Schultze, of the Prussian artillery, has brought in the sporting powder identified with his name, consisting of wood converted into nitro-cellulose. In its best form this closely resembles a granulated nitro-cotton powder made at Stowmarket. Absolute smokelessness was not, however, attained, nor a high degree of accuracy. The smokeless powder of Messrs. Johnson & Borland, and of the Smokeless Powder Company, are well established compounds in England. Camphor has been used with success to harden the surface and close the pores of the powder granules now used. In French and German smokeless powders, acetic acid and acetone have been used, not merely to harden the tablets or granules, but to convert them into horn-like material. The first powder used with the Lebel rifle took the form of small yellowish brown tablets as thin as stout note paper. The composition was made a mystery of, but apparently it contained picric acid—the basis of melinite. The powerful and much vaunted French explosive employed in shells has for its basis picric acid, which was first used by Designolle about twenty years ago. The earliest smokeless French powder undoubtedly failed in the quality of stability, and has been superseded by a simpler compound. German powder of great promise, elaborated at the Rothweil powder works, failed from the same defect of instability. Guncotton of low explosive power has, by the use of solvents, been converted into horn-like material, and pressed into the shape of rods, tubes, sheets, and other forms, which may be cut up into tablets or strips of any required shape. Mr. Alfred Nobel, the inventor of dynamite and other powerful blasting agents depending on nitro-glycerine for their basis, also made smokeless powder based on guncotton in the above form, bearing considerable resemblance to his blasting gelatine. Col. Hess, in Austria, rendered this substance less susceptible to accidental explosion by the incorporation of camphor previously used in the manufacture of the curious substitute for ivory, horn, etc., known as xylonite. Mr. Nobel has had some success in Italy with his smokeless powder, with which Krupp is also said to be experimenting. The government committee on explosives have used Nobel's powder and others in the form of wires and rods in bundles in small arms with excellent results. The most promising of them, besides fulfilling the conditions of smokelessness and stability, has developed much greater energy in small-bore arms. Considerable erosive action is produced, and the arm is heated, while but little fouling is produced. Success with small arms seems on the eve of attainment with smokeless powder, and its application to larger barrels of from 1·85 in. to 6 in. in caliber is attended with less difficulty. Probably the form of the gun will need modification, the pressure in the chamber being less and in the bore greater than with black powder. In our service the need for resisting climatic action of all kinds involves unusually great difficulties, and modifications in our system of magazines may be necessary.

As to the effect on operations of war, much license has been given to the imagination as to results arising from the use of powder from which noise as well as smoke has been eliminated. This has no foundation, the noise of smokeless powder differing only from that of black powder by being rather sharper and of shorter duration. German field guns and our own experimental pieces are fired with powder generating a very slight smoke, like the puff of a cigar, which is instantly dissipated. Independent rifle firing is not visible at 300 meters distance. The main effect in battle will be to increase the elements of calculation, leaving less to chance.

RECENTLY in Sweden a glass composed of fourteen substances, of which phosphorus and boron are the most important, has been produced.

MANUAL INSTRUCTION OF THE MECHANIC.

It has often been said that there is no good general without good soldiers. How true is this aphorism in industrial conflicts, wherein the engineer could not carry on his great enterprises successfully without a select *personnel*, and without the aid of skillful workmen trained to the practice of the manual arts. A good method of instruction in mechanics is consequently one of the most important of matters, from a scientific as well as from a social point of view. Such a practical and wise method, which has hitherto been wanting, has just been realized in a manner that we should be tempted to qualify as perfect, so long has it been studied and so ably arranged. The author of this interesting work is Mr. Denis Poulot, for whom, after an experience of forty years, the machine shop has no more secrets. Mr. Poulot's method of manual instruction,* which we have recently taken great pleasure in

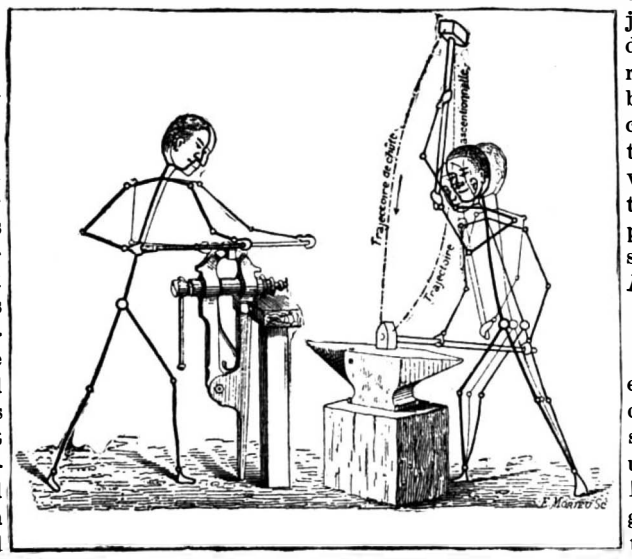

Fig. 4.—DIAGRAMS SHOWING THE NORMAL POSITIONS OF THE BODY IN FILING AND HAMMERING.

studying in all its details, will render the greatest services to all workshops, to all professional schools, and to all students of physics and mechanics, who are now so numerous. All those who handle the hammer, and who know how to strike the anvil or to work in the laboratory, will agree that it is a valuable thing for the man of research to know how to make, immediately and unaided, the apparatus that has just been conceived, and that he is impatient to experiment with. To all those whom such work interests, either as professors or workmen, we recommend Mr. Poulot's method. The author begins with hygiene and costume, and gives advice as to what is to be first done, in case of wounds received from the hammer, chisel, etc. Then he goes on to describe the methods of filing, chiseling, boring, etc.

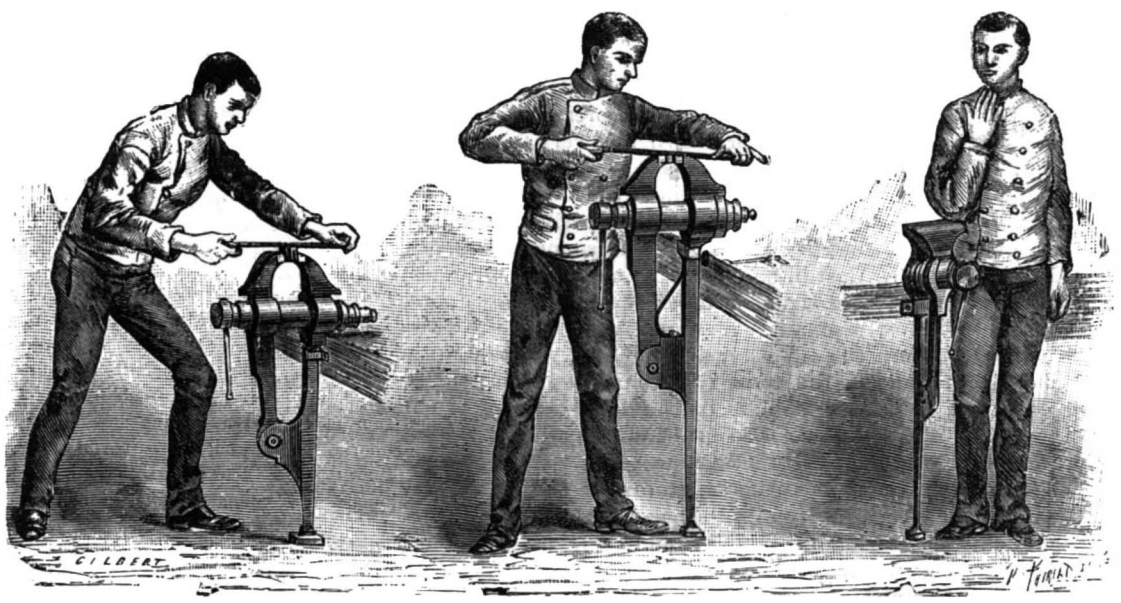

Fig. 1.—VISE TOO LOW. Fig. 2.—VISE TOO HIGH. Fig. 3.—METHOD OF GETTING THE HEIGHT OF VISE.

In order to give an idea of the ingenious manner in which Mr. Poulot instructs his pupils, we reproduce from his "Method" a few figures relating to work with the vise.

Fig. 1 shows us a vise placed too low, Fig. 2 represents one placed too high, and Fig. 3 shows us how the pupil can determine the proper height of the vise, by putting the apparatus at the level of the elbow when the arm is bent and the hand placed under the chin.

Mr. Poulot has produced excellent diagrams for giving the attitude of the body and arms in the various operations of the mechanic. We reproduce two of these, one relating to filing and the other to hammering (Fig. 4).

Mr. Poulot's method is divided into three years of instruction. The first year comprises elementary motions relative to the mechanic's working stock, the elements of the work of the forge, of the fire, fuel, etc. The second year is devoted to the nicer sorts of work. It treats of the management of measuring instruments, of wire drawing, of the lathe, of tools for screw cutting, of brazier's work, of transmissions, etc. The third year comprises the execution and mounting of machines.

Mr. Poulot's work is deserving of the greatest praise, and will render the greatest services.—*La Nature.*

* "Methode d'enseignement manuel pour former un mecanicien," Paris, Monrocq freres. 1889.

Aqueous Solutions of Essential Oils.

It has been found by Bergmann that while mixtures of the fixed alkali soaps with hydrocarbons and essential oils form only emulsions in water, under separation of the respective oils, a mixture of an ammonia soap with an essential oil will form a clear solution in water, especially in presence of an excess of ammonia (*Chem. Zeit.*, November 6). Turpentine oil, or some other essential oil, is first mixed with castor oil, or a mixture of it with some other fat oil, the mixture is then subjected to the action of concentrated acid, and the product, after being washed with solution of salt, is saturated with ammonia in excess. Or the fat acids may be first separated by treatment of the fatty oil with concentrated acid, then washed with salt solution, and the essential oil added either before or after saturation with ammonia. The preparation thus obtained is said to form a clear solution, and not only to possess the properties of a soap, but also to exercise, in aqueous solution, the solvent action of an essential oil.—*Pharm. Journ.*

Casting Great Guns in Rhode Island.

The twenty-fifth mortar of the thirty that the government ordered last year of the Builders' Iron Foundry, Boston, Mass , was successfully cast the other day, says the Boston *Advertiser*. The work is being done under the inspection of ordnance officers Capt. A. H. Russell, Lieut. D. A. Howard, and Sergt. Flynn. The guns are known as 12 inch breech-loading rifled mortars, cast iron, hooped with steel. The first contract is to be fulfilled April 2, 1890. The first casting, an experimental one, was made March 12, 1889. This was cut up into many pieces for tests, to ascertain the mechanical properties of the iron used and for information concerning initial strains in the mortar body, produced by cooling from the inside of casting. All the requirements of the ordnance department were satisfactorily obtained in this casting, and following it as a standard, the first casting to be used as a mortar body was poured April 6, 1889, since which time castings have been made at stated intervals. When it is considered that these mortars, when fired, are expected to put their shot within a target 10 feet wide, the accuracy with which they must be bored, rifled, and mounted can be imagined. Much new machinery for this work is now being delivered, consisting of milling, slotting, boring, and turning machines, gun lathes and rifling attachments. During the war this establishment built many of the heaviest naval guns, but the changes that have taken place in gun making since that time necessitate entirely different machinery. These mortars are intended entirely for coast defense, and the fortifications already contemplated include many hundreds of these guns. In anticipation of this need the Builders' Iron Foundry is building up the largest private gun manufacturing plant in the country. The mortars are 11 feet long, and with the steel hoops shrunk on weigh 15¼ tons each. They are designed to be operated in groups of 16. They will be hidden from the enemy by embankments, over which they will be fired. The firing will be directed entirely by one officer, who, by previous study of a chart, can put his shot in any section of a harbor he chooses.

The regular charge is 80 pounds brown prismatic powder, giving a muzzle velocity of 1,150 feet, the projectile weighing 630 pounds, with a pressure of about 28,000 pounds per square inch on the powder chamber. The range of these mortars with this charge and projectile, with an angle of 45 degrees, is about six miles. The shot at that distance will pierce six inches of steel armor plate. The accuracy of fire is such that with ordinary care every shot can be delivered at this distance within an area covered by the deck of an ordinary vessel.

Cost of the Forth Bridge.

The original estimate of the cost of this great work was $10,500,000; but the actual cost has been about $15,000,000, or nearly the same as the bridge between New York and Brooklyn.

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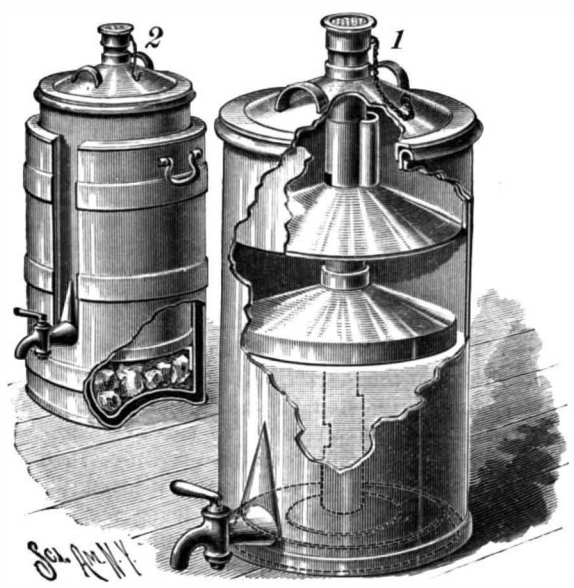
AN IMPROVED MILK CAN.

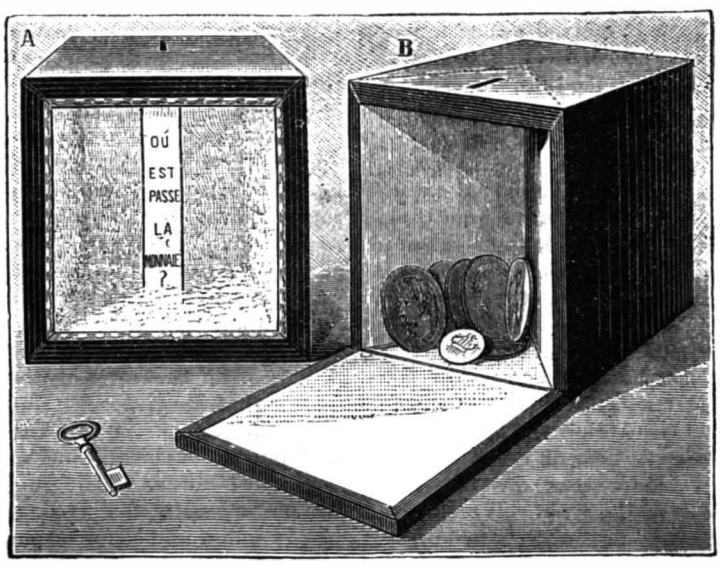
The accompanying illustrations represent a milk can provided with an efficient surface cooler or refrigerator for keeping the milk constantly cool and sweet, with a device for carrying off the heat of the milk, one illustration showing a shipping and the other a delivery can. The invention has been patented by Agnes W. H. Smith, of Beaver Dam, Wis. The can is provided with a perforated dasher on the lower end of a hollow stem which has side apertures at intervals nearly to the top of the can body, and on this central tube is fitted a float which lies on the top of the milk, to prevent excessive agitation or churning of it while the can is in transit. The can also has a surface cooling top or cover made with an ice-receiving vessel, which fits closely in the top of the can, and has a curved marginal flange, as shown in Fig. 1, under which rests a packing, making an air-tight joint between the top of the can and the ice box. The bottom of the box is highest at the center, where it has a hole through which the central air tube passes, next to which is a cold air passage to the top of the box. The top of the central tube has a perforated cap preferably held to the cover by a tie chain, to exclude dust from the tube and milk. The drip from the melting ice does not flow into the milk, but collects in the outer sloping bottom part of the box, the cold air from which flows downward through the tube into the body of the can and on to the milk around the float, or directly on the entire upper surface of the milk should the float be dispensed with. In Fig. 2 the can is shown provided with a jacket having an ice pocket in its lower portion.



SMITH'S MILK CAN.

THE MAGIC MONEY BOX.

Among the experiments in physics, there are perhaps few that were formerly as popular as the one in which a human head, capable of speaking, was seen lying upon a three-legged table beneath which there appeared to be nothing. The body to which the head belonged was in reality in the table, the head passing through an aperture and the body being concealed by two mirrors inclined at an angle of 45° with respect to the walls at the right and left of the little hall in which the experiment took place. The image of the walls was confounded with what was seen of the wall to the rear. An ingenious manufacturer has utilized the principle of this experiment (which could be performed only with the outfit of a prestidigitator) in the production of an amusing little toy. It is a magic money box formed of a square box having a glass in one side and lined with wadding. When a coin is put into the slot at the top, it falls and immediately disappears. Where has the money gone? That is the question that is proposed on a printed slip in the interior, and which it is not always possible to answer.



MAGIC MONEY BOX.

The box in reality is formed of two parts, as may be seen in the figure (B) to the right. The compartment into which the coin drops is concealed by two small mirrors at an angle of 45°, exactly as in the experiment mentioned above.—*La Nature.*

A Locomotive Explosion.

An explosion which shook every house in Benwood occurred February 15. The trouble was with the boiler of Baltimore and Ohio locomotive No. 442, of which Alfred Cunningham was engineer and David Goehring fireman.

The engine was going past the station at the rate of about four miles an hour. When the boiler exploded, and when the steam cleared away, there was nothing left of the engine save the steel frame, driving wheels, and truck, surmounted by some tangled and twisted bars, rods, and tubes. The force of the explosion was such as to damage the track and tear up the platform in the vicinity, while a car load of furniture which was standing a short distance away on another track looked as though it had been subjected to a half hour's bombardment by a field piece.

In a very few moments a large crowd was attracted to the scene, and a search was at once begun for the engineer and fireman. It was supposed, as a matter of course, that both men had been killed, but, to the great surprise of all, both men were not only alive, but comparatively well.

Engineer Cunningham was thrown by the force of the explosion over the freight cars which were standing on the side track, to and over the track of the Ohio River Railroad, and finally alighted in an old corn field. He was not much the worse for his rapid transit, and when it is considered he cleared one hundred and sixty feet at one flying leap, his escape seems little short of miraculous. Before he was found he had got on his feet and was walking back to where his engine had stood. To a newspaper man Engineer Cunningham said:

"I was carrying 130 pounds of steam, and as we approached the station there were three gauges of water. About twenty yards north of the station building I threw the injector on, and we ran on past. The explosion then resulted."

Fireman Goehring was found lying between two cars. He, the rear portion of the boiler and fire box, and the fragments of the cab, all left the engine about the same time. The iron work fell first, and then Goehling settled down, with the remains of the cab lying over and partly on him. He went toward the bank, and when found was bleeding profusely from cuts about the head and face. A flying fragment of iron struck Track Foreman Boyd in the calf of one leg, causing a painful wound, and a fourth man, one of a group of five or six who were standing on the platform when the explosion occurred, was slightly cut in the side of the face by a piece of sheet iron. These comprise the casualties.—*Safety Valve.*

Kenyon's Substitute for India Rubber.

The substitute consists essentially of a preparation of oxidized linseed oil, such as the skins and refuse of boiled oil. In carrying out the invention, oxidized linseed oil is mixed with a liquid in which it will dissolve or with which it will combine when heated. The solvent material preferably used is the distillate produced in the manufacture of varnish from gums or gum resins, although varnish foots, pine oil, or thick pine grease, resin, resinous oil, or a mixture of two or more of these or other similar substances will also act as solvents when heated. The varnish distillate or other solvent is placed in a pan or still heated by steam or otherwise, and the skins of boiled oil or oxidized oil added and mixed well together (or they may be mixed prior to being placed in the pan). The proportion of the solvent to the oxidized oil will altogether depend on the consistency of the product desired. To make the product of about the consistency of raw India rubber, one part of the varnish distillate to three parts of the boiled oil skins is used; but to produce a substance of a thick, treacly consistence, equal parts of each. The mixture in the pan is then heated to about the temperature of boiling oil, say 350° to 450° F., and maintained at that heat for a considerable time until all the hard or oxidized masses of oil are dissolved in or thoroughly incorporated or combined with the varnish distillate or other solvent used (say from twelve to twenty-four hours).

AN English electrician has invented a material that he calls "alterion," for the prevention of corrosion in boilers. The interior of the boiler is coated with the material, and from time to time electrical currents are sent through it.

AN IMPROVED BARREL TRUCK AND JACK.

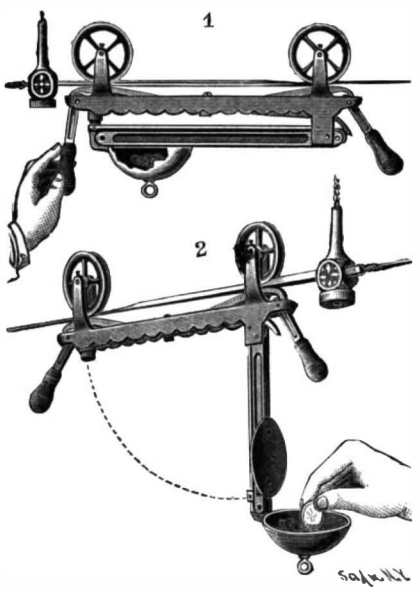
The accompanying illustration represents a hand truck for barrels containing oils or other merchandise to be drawn off or retailed from the original packages. It has been patented by Messrs. James H. Stansbury and Isaac U. Hyatt. Upon the forward cross bar of the truck frame are secured two metal chocks, having curved upper faces adapted to receive a barrel. The truck wheels are on an axle journaled in fulcrum plates bolted at their rear ends to the side bars at about the center, and forward of the wheels the plates are gradually curved upward to the forward ends of the side bars, where they are rigidly fastened, and at these points angled nose plates are secured to the upper face of the side bars, adapted to be entered beneath the chine of a barrel. The relative arrangement of the nose plates and roller fulcrum with the wheels allows the truck to overbalance forward but little when loading, and enables one man to easily handle a very heavy barrel. On the handle part of the truck frame is supported a vertically adjustable concaved saddle, on which and the front chocks the barrel or hogshead firmly rests. At each end of the saddle there is preferably formed a hook, allowing connection of opposite ends of a stay chain or cord passed over the barrel to hold it snugly to the saddle while the truck is being tilted downward after inserting its nose plates under the chine of the barrel.

STANSBURY & HYATT'S BARREL TRUCK AND JACK.

For further information relative to this invention address Mr. James U. Hyatt, Jamaica, N. Y.

AN IMPROVED CASH CARRIER.

The accompanying illustration represents a simple and compact cash carrier for a store service system, in which the cup is permanently attached to the car, and consequently not liable to be misplaced or lost, while the car requires but a slight effort to propel it along the wire. The wire at either end, next the stop, is increased in thickness, this portion being approached by a slight bevel, and as the car wheels ride up this portion of the wire toward the stop a spring brake on the car engages the periphery of the wheels. There is also a rubber buffer on the stop by which, in connection with the action of the brake, the car is brought to a standstill without noise or jar, even if its motion had been excessive. The car never fails to catch and never rebounds, while it requires but a slight turning of the handle at either end to release the brake when the car is sent on its way. Fig. 1 shows the car with the cash cup in position to be sent along the line, Fig. 2 illustrating the manner in which it is brought to the open position, being always held upright, the closing of the cup to the bottom of the car being effected by simply pushing the cup up by the ring on its bottom. This cash carrier has been for some time in successful use and is highly commended by those who have it. For further information relative thereto address the Fuller Cash Carrier Co., Meadville, Pa.



THE FULLER CASH CARRIER.

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A Triumph of Education.

To every one interested in the welfare of the deaf and dumb the success of the oral training system, as lately exhibited at a theatrical performance of "Richard III." by the children at Old Kent Road Asylum, must convey an impression of deep satisfaction. If a certain slowness of utterance or an occasional jarring intonation still reminded one of the lacking faculty, this is hardly surprising. These imperfections time alone will do much to remedy. It is far more remarkable that young people who could not remember having heard the human voice were able, with very fair acceptance, and with evident intelligence, to render in speech one of the masterpieces of the drama. Such a feat, we need hardly say, would have been quite impossible under any other but the oral method. The success of the performance, moreover, speaks volumes for the skill and patience possessed by the teachers employed in carrying this system into effect. No process of training exacts more of its communicators; none, perhaps, more distinctly requites their laborious efforts, and certainly none endows the learner more abundantly. It is customary with many in this country to speak of the lip-reading system as an educational novelty; yet it is far from being such. For centuries it has divided the field with one or other of the sign methods, and probably has always exerted a relatively great or even a preponderating influence. It was known and taught with success in Spain during the sixteenth century. It was used by Wallis and advocated by Dalgarno a century later in England. Under Braidwood and Watson it afterward achieved some of its most brilliant successes. Nay, it continued to flourish side by side with the convenient but far less efficient manual method introduced by De l'Epée and Sicard, and adopted from their school by teachers in Great Britain and America. While, therefore, we must chiefly thank Samuel Heinecke and his followers for fostering in its original form the precious germ of imitative speech properly so called, we must also remember that what he brings us is not in truth novel, but is a once neglected part of the educational patrimony of almost every European country. If a long list of recorded successes which reaches us from ages now becoming remote, and the proofs of striking success attained in our own day, afford the means of judging, we may safely conclude that both teachers and taught will agree to retain in chief esteem a method which has accomplished so much. Between the clear and intelligent utterance which it insures and the uncouth vocal ventures of the sign-taught mute there is indeed no rational comparison.—*Lancet.*

Kangaroo Skins.

When brought to bay, the kangaroo jumps like a flash for a hunter's chest, and tries to crush it in with his fore feet. To prevent this, each man wears across his breast a two or three inch thick matting. Armed with a spear, with a club attachment at the other end, they ride upon swift horses into a herd. With the agility and equipoise of circus riders, they stand erect upon their horses, and use their spears and clubs. The kangaroo is able to jump clear over a horse. As the game is bagged it is skinned, and the skin is stretched on the ground and pegged down to prevent shrinkage. The flesh furnishes meat for the camp. Each man places his private mark upon his booty, and when they have one hundred skins apiece, they return back to civilization. There are twenty varieties of kangaroos, among them the blue, red Wallaby, black, gray, and forester, the latter furnishing the best leather, as it lives mainly in wooded sections.

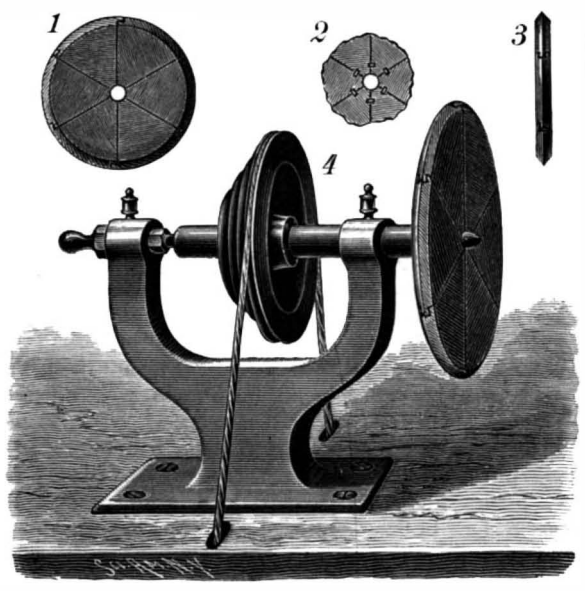
When the shipping ports are reached, the hunters dispose of the skins by auction to the highest bidders, the skins being now in constant demand. Kangaroo hunters make large profits. One man is known to have cleared $4,500, free of living expenses, in a single year. The tanning of kangaroo skins is confined to men employed by Americans, as other dealers cannot afford to pay the high prices for the raw material. The result is that Parisian and London shoe manufacturers buy their stock of kangaroo leather directly from Newark, and prominent dealers in Germany, Greece, Spain, and even Australia itself, obtain their supplies from the same source. The manufacturer here scouts the idea that the original seven league boots were made from the skin of the great Australian leapers.—*Nature.*

Injury to Neighbors' Water.

Where one stores oil on his premises in such a way that the leaking oil penetrates the ground, and thus pollutes his neighbor's spring, he is liable to his neighbor for the injury that results, although he may have been ignorant of the fact that the oil was affecting the water of his neighbor's spring, according to the decision of the Kentucky Court of Appeals in the case of Kinnard *vs.* Standard Oil Company. The court held that while the owner of the land may appropriate to his own use hidden or undefined veins of water under his soil, and thus cut off the supply of water from a neighbor's well or spring, he has no right to contaminate the water so as to render it unhealthy or unfit for use when it reaches his neighbor's land.

AN IMPROVED GLASS POLISHING WHEEL.

The illustration herewith represents a wooden polishing wheel composed of sector sections, each so cut and connected to the adjacent sections that the grain of the wood of each section will run at about right angles to the forward radial edge of the section. It has been patented by Mr. Wyman Kimble, of Honesdale, Pa. Fig. 1 is a side view and Fig. 3 an edge view of such a wheel, in which the sector sections are united by dovetail projections, Fig. 2 showing a construction wherein the dovetail joints are dispensed with and the sections are united by tongue and groove connections, with double-pointed tacks applied over the joints. A wheel



KIMBLE'S GLASS POLISHING WHEEL.

thus formed is especially designed to maintain an even wearing surface upon its peripheral edge, while readily taking the proper shaping upon its operating edge from the sharpening tool.

Improved Process for Fixing Colors.

This invention, by F. Bayer & Co., Elberfeld, Germany, relates to an improved process for fixing coloring matter, such as the azo-dyestuffs, which possess the property of directly dyeing unmordanted cotton in an alkaline bath, and which are known in the trade as substantive coloring matters, on or in the animal or vegetable fibers to which they are applied in the processes of dyeing and printing. The said substantive coloring matters possess the property of forming, with the salts of the earthy and of the heavy metals, lakes which in part are very permanent. By boiling in a solution of a metallic salt goods which have been dyed or printed in the usual way, the metal becomes fixed by the coloring matter in the form of a fixed lake. The results obtained naturally vary according to the nature of the metallic salt and coloring matter employed. Zinc is found to be the best suited for use in dyeing wool and silk, as it has no influence whatever on the color, and forms lakes which perfectly resist the action of boiling water, and better resist fulling or milling than do the original colors. The zinc can be employed in the form of sulphate of zinc or white vitriol. Woolen goods dyed in the usual way, with deltapurpurine for example, are boiled for a few minutes with a quantity of white vitriol corresponding to the dye employed. The zinc is then completely taken up from the bath. The wool so treated is now faster to fulling or milling, and can be acted on with boiling water without suffering in the least. The dyestuffs are preferably employed in printing with an addition of neutral thickening paste.

A NEW MACHINISTS' HAMMER.

The illustration herewith represents a new style of standard hammer for machinists and blacksmiths which has just been brought out by the Billings &

Spencer Company, of Hartford, Conn. These hammers are drop-forged from the best tool steel, and are carefully tempered and finished in the thorough manner for which this company has so well established a reputation. They are made in four sizes, ¼, ¾, 1¼, and 1½ pounds, respectively, and particular attention is given to the handles in regard to shape, elasticity, and "hang."

Correspondence.

Hektograph Pad—French Formula for Composition.

To the Editor of the Scientific American:

"*Hektograph Pad.—French Ministry of Public Works.*

Glue	100 parts
Glycerine	500 "
Finely powdered kaolin or baric sulphate	25 "
Water	375 "

"For ink a concentrated solution of Paris violet is recommended.

"To remove old copy from pad, a little muriatic acid is added to the water."

This is the 25th copy from pad made according to above formula.

For a tin dish 7×11 inches I used:

Glue	3 oz.
Glycerine	15 "
Kaolin	¾ "
Water	11¼ "
	30 "

I had to guess at weight of glue and think that I got a trifle too much. WM. T. PEPPEREL.

Boston.

[The quality of the sample submitted speaks well for the formula, which varies in some points from that given in our SUPPLEMENT, No. 438.—ED.]

Oxygen Explosions—Their Cause and Prevention.

To the Editor of the Scientific American:

I was much interested in your article in the SCIENTIFIC AMERICAN in reference to the explosion of an oxygen retort at Lexington, Ill., by which Prof. Jess and a number of others were severely injured.

In my experience of a number of years in the manufacture of oxygen for the lime light and other scientific purposes, I have become convinced that a large numbers of explosions are the result of a sudden plugging of the neck of the retort and outlet pipe with the binoxide and decomposed chlorate.

Some years ago, while working with an extemporized retort similar to Prof. Jess', composed of 2 or 2½ inch iron pipe, about 10 inches long, one end closed and the other capped with a reducing cap into which was screwed a ½ inch pipe, the retort exploded violently, but fortunately injuring no one. The retort had been inclined at an angle of 45° over the source of heat, and the gas coming off slowly, I turned the retort to expose a fresh surface. The retort exploded a moment later. As the retort had been carefully cleaned, and as samples of the same lot of chemicals, when used in another retort, gave no bad results, I formed the opinion that the discharge pipe of the retort had been plugged by a sudden rush of gas, and the explosion followed. For several years I have used a conical retort of heavy sheet iron, about 8 inches diameter at base and 2½ inches at top, this fitted with a loose-fitting cap of copper or iron, with connection, and when used a joint made with fire clay. I have never had the slightest accident with this form of retort, and commend it to all.

C. LUCIUS WOOLLEY.

Baltimore, Md.

A New Explosive Compound.

Mr. H. S. Maxim has discovered that the addition of castor oil, or other suitable oil, to compounds of dissolved guncotton and nitro-glycerine, nitro-gelatine, or the like, increases the toughness of the product and modifies the explosive properties thereof, while greatly diminishing its liability to deterioration by exposure to the atmosphere. Castor oil is preferably employed, because it is soluble by means of the solvents which are employed for dissolving the guncotton and nitro-glycerine or nitro-gelatine. The improved explosive compound is advantageously manufactured as follows: First, dissolve guncotton or trinitro-cellulose in acetone, ethylic acetate, or a similar solvent, either in a liquid state or in the form of vapor, until the said guncotton is brought to a sufficiently thin consistency, and then add to the dissolved guncotton the nitro-glycerine or nitro-gelatine, and after that the castor oil, and thoroughly incorporate these substances. Or the castor oil may be dissolved in a portion of the acetone, or other solvent, before the solvent is added to the guncotton. When the mixture is sufficiently dissolved, it it subjected to pressure in a cylinder, and so forced out through small holes in the form of threads or strips, which may be cut into small pieces.

Length of Locomotive Boiler Tubes.

Some interesting experiments have recently been made by the Paris, Lyons, and Mediterranean Railroad on the comparative value of short and long tubes in the locomotive boiler. As a result of these experiments the road has adopted standards for lengths of tubes, varying from 13 feet to 14¾ feet. With boilers having tubes of these lengths there was found a total evaporation in a given time about 5 per cent greater than with boilers having tubes 16½ feet in length, but there was a loss on the water evaporated per pound of coal varying from 2½ to 5 per cent.

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THE SAN DIEGO FLUME SYSTEM.

The dreadful calamity at Hassayampa, Arizona, a few days ago, which caused such great destruction of life, has attracted attention to the system of artificially watering the parched, arid plains of the rainless region of the West by the use of dams and flumes. Much waste land in the West has recently been redeemed by irrigation. The dam lately destroyed at Hassayampa was built in order that the sterile plains with which that part of Arizona abounds might be irrigated. This system of overcoming the defects of nature by artificial means will be extensively used in the future, when the population in those regions has become dense enough to create a greater demand for farm land than exists at present. Then that desert land will be looked at longingly, and those dreary wastes will be transformed into fertile plains, and will perhaps be studded with flourishing towns.

One of the most perfect and extensive works of this nature is the San Diego Flume System, which has recently been completed, and which is designed to supply water to the city of San Diego and to irrigate the surrounding *mesas*, now simply barren deserts, with no vegetable growth save the cactus and the sage bush. But the days of these plants are numbered, and the inhabitants of that region are now looking forward to the conversion of this dreary region into flowering prairies.

San Diego is situated at the extreme southwestern limit of California, on a splendid bay. It is the southernmost American harbor on the Pacific coast. When the first railroad was brought into San Diego, in 1881, the population was 3,000. Now she claims a population of 35,000, and it would appear that the port was likely at no distant day to become one of the most important of the Western seaports. Distant nearly 500 miles from San Francisco, she is nearer Australia, South America, the Nicaragua Canal, and most of the Pacific Islands than is San Francisco, and by rail she is nearer Salt Lake City and nearer New York than is the Golden Gate.

The country, however, like much of that immediately east of the Rockies, and like the peninsula of California, lacks water, and it is to the end of remedying this defect that the flume system described below has been constructed.

Mr. Bryant Howard, president of the Flume Company, at the ceremony that took place to celebrate the opening of this great work, in the course of an admirable speech spoke with pardonable enthusiasm as follows:

"The county of San Diego, which, because it is only a county, we are apt to think of as of small size, is yet larger than several of our States. It is larger than the States of Massachusetts, Rhode Island, and Connecticut combined. It is larger than some of the kingdoms of Europe. Though a large portion of it is desert and mountain, it has more fertile land within its borders than Palestine when Solomon reigned in his glory, more than Greece when Pericles reared the Parthenon. It is one of the most favored regions of the whole earth. Its scenery is grand and beautiful; its skies soft as those of Italy; its valleys and *mesas* unsurpassed in fertility; its hills and mountain sides are covered with flowers yielding treasures as precious as those of the famed Hymettus; its air is balmy as the breezes of 'Araby the Blest.' Here no thunderbolts destroy, no tornadoes bring devastation, no torrid heat enervates, no frigid cold benumbs or paralyzes. Here malaria can find no foothold; here the sunshine and ocean breeze give life to the blood, elasticity to the step, the bloom of health to the cheek.

"But one thing we have needed. Our fertile hills and valleys and *mesas* are sometimes dry and barren. Thirsty earth cries for drink, and her thirst is not always quenched. The harvest has not always come to reward the labor of the farmer. The one thing we lacked is water. For here water is king. And now he comes to us in all his glory. He comes from the mountains, and all the valleys and *mesas* rejoice at his coming. In his footsteps shall spring herb and flower and fruit and grain. He shall wave his scepter over the land, and beneath it shall oil and wine and milk and honey flow.'"

The water is brought to San Diego, a distance of fifty miles, from the lofty Cuyamaca Mountains, where there is abundance of rain. The annual rainfall averages 30 or 40 inches. The living streams flow during all the year. By means of tunnels and trestles the water is conducted through the whole distance with an even fall of some 4·75 ft. per mile. The current flows at the rate of four miles an hour. The supply reservoir at the western terminus of the flume for the uses of the city is 630 ft. above the sea level, and it was for the purpose of retaining this high elevation that such extensive trestle work was necessary. At this point the water is filtered, and is brought eight miles to the city through a fifteen inch pipe.

The original source of the supply is the Cuyamaca reservoir, located in the mountains at an elevation of 5,000 feet above the sea level. It holds 3,739,000,000 gallons of water, but, in case of necessity, the dam can be raised several feet and the capacity doubled or trebled. The dam is made of clay, and is 720 feet long, 35 feet high, and 140 feet wide at the base, 16 feet at the top. The front is riprapped. It is estimated that the watershed at present concentrated is some 150 square miles in extent. The water as it leaves the reservoir flows through the natural bed of a brook through a narrow gorge called Bowlder Creek, a distance of twelve miles to the diverting dam.

This is a splendid structure, built of granite and cement, 450 feet long and 35 feet high, 16 feet wide at the base, and 5 to 7 feet wide at the top. From the diverting dam the water passes into the great flume. This is 35 6 miles long, 6 feet wide, and 16 inches high. The side boarding will be raised to four feet as soon as the supply demands it. It is built of dressed redwood plank two inches thick, resting on heavy wood sills, stringers, and cross ties, and the whole resting on a solid foundation. Over 9,000,000 feet of lumber was consumed in this work. Redwood was selected owing to the fact that water does not have the same deleterious effect upon it that it does upon other woods.

In the construction of the flume there are 315 trestles, the longest of which is the Los Cochos trestle, 1,774 feet in length and 56 feet high. Its construction required 250,000 feet of lumber. Some of the others are: The Sweetwater pass, 1,264 feet long and 81 feet high; Sycamore Creek, 720 feet long and 35 feet high; Connor Creek, 688 feet long and 34 feet high; Knob Creek, 600 feet long and 55 feet high; Cut-off, 640 feet long and 48 feet high; Sand Creek, 600 feet long and 58 feet high; South Fork, 420 feet long and 86 feet high; Quail Canyon, 560 feet long and 68 feet high; Monte, 438 feet long and 60 feet high; Chocolate, 450 feet long and 63 feet high.

There are over three hundred smaller ones. There are a number of tunnels cut through the solid granite or slate six feet square, cemented and arched overhead, supports being placed wherever the rock was in danger of falling. The principal ones are the Lankersheim Tunnel, 1,900 feet long; Los Coches, 313 feet; El Monte, 290 feet; Cape Horn, 700 feet; South Fork, 200 feet; Anderton, 270 feet; and Sand Creek, 430 feet.

The project of erecting this flume was conceived of many years ago by Mr. T. S. Van Dyke, and for many years he and Mr. Wm. E. Robinson tried to interest the public of San Diego and procure capital for the enterprise which has recently been brought to a successful issue. Work was commenced in 1886. In many places roads had to be constructed to facilitate the transportation of the timber, and over 100 wagons and 800 horses and mules were employed in transferring the lumber from the ships in the harbor at San Diego to different points in the mountains. The lumber was hauled by teams in caravans, consisting of several wagons dragged by teams of six, eight, or ten horses each. The lumber was cut and fitted at the city in order to avoid unnecessary hauling. The cost of the work has amounted to about $1,000,000.

It is estimated that, in addition to furnishing the city with a splendid water supply, it will be possible to irrigate from 40,000 to 100,000 acres of land. This land has hitherto been worthless, but with an abundant supply of water at hand it is only a question of time before this tract will be converted into flowering gardens and prosperous farms, for the soil is productive and the climate delightful. Part of this land has been acquired by the flume company, and is being worked with a view to converting it into productive property. There are a number of summer flowing streams that can be diverted into the flume in the Cuyamaca Mountains as soon as this becomes necessary, and other reservoirs will be constructed at different points. One of these, near the La Mesa tract, will contain 760,000,000 gallons, and another above the Diverting Dam 1,250,000,000 gallons.

In one of our views we represent a party of pleasure seekers in the act of floating down the flume.

This system, which we have taken as a type, is, however, only one of many in this same county of San Diego. There are seven other similar systems, either completed or in course of construction. It is claimed by some that the land is enhanced in value $100 per acre, and some idea can be formed of what this work means to that country when it is remembered that from 500,000 to 1,000,000 acres will be benefited by these works. We also give an illustration of the Sweetwater Dam, recently erected to furnish a water supply to National City (near San Diego) and the National Ranch. The names of other systems in that same region are Tia Juana, Sweetwater, Bernado, San Luis Rey, Santa Margarita, and San Jacinto.

It is an interesting study to those living in a community where the conditions of society are pretty well determined to think of a people who are living in a city that has increased tenfold in eight years and that are calmly waiting for the country about them to gradually change from a cheerless desert into a blooming garden. They are not dreamers and romancers, looking for some work of magic, but practical business men looking forward to the season of transformation with the faith that comes of well-considered plans and long studied design. They are looking to a literal reconstruction of nature and to an extension of the possibilities of their material growth that implies an entire reversal of the present order of things. Their material extension as a people was limited; but now the barrier that bound them has been removed, and they are waiting with a calm that is sublime for the new possibilities of an extended development and a new and more diversified civilization.

The Proposed Great Bridge between New York and Jersey City.

Engineer Lindenthal, who designed the projected bridge across the Hudson River at New York, lately explained to a sub-committee of the House of Representatives Committee on Commerce the details of the proposed structure.

The committee has received the reply of the secretary of war in answer to an invitation to express his views upon the bill. The secretary indorses and transmits a letter from Gen. Casey, chief of engineers, in which he says that the bill was referred to the Board of Engineers stationed at New York. Upon their findings he suggests that the center of the span shall be 155 feet above mean tide, and that a section shall be inserted requiring the plans to be submitted to the secretary of war within one year from the passage of the act, the construction to begin within one year after that, and the bridge to be completed within ten years from the approval of the plans. Gen. Casey says that, with these amendments, he knows of no objection to the passage of the bill so far as the interests of navigation are concerned.

In the course of his argument Mr. Lindenthal commented upon these recommendations adversely. He said that the company would be willing to have the center of the bridge 145 feet above tide water, which would be 10 feet higher than the Brooklyn Bridge, but to make the bridge 155 feet high would add enormously to its cost, and would render it almost impossible so to grade the approaches as to afford access to railroad trains. The best plan to adopt would be to fix the height tentatively at 145 feet in the bill, leaving a board of engineers to take testimony from navigators and railroad men and definitely settle the matter.

Mr. Lindenthal also contended that the time allowed by Gen. Casey for beginning the work was entirely inadequate. Vast preparations would have to be made to get together material for a structure unlike any other in the world in size and design. It would also be necessary for the company to acquire about thirty million dollars' worth of property in real estate for the approaches and right of way, and this was a time-consuming proceeding. He was willing to accept the suggestion of Chairman Baker that the bill should provide for the beginning of the work in three years, with a proviso that the secretary of war might grant an extension upon reasonable grounds.

Mr. Lindenthal said that it had been his task for the past five years to convince the public, and particularly capitalists, of the feasibility of his plan of throwing a single span bridge, 3,000 feet long, across the Hudson River, a plan which no other engineer had the courage or ability to put forward. As a result of his work he had secured the indorsement of the American Society of Civil Engineers and had gotten the support of capital for the construction of a bridge which in itself would cost $16,000,000.

In conclusion and in answer to questions, Mr. Lindenthal gave some interesting statistics relating to the bridge. Its central span would rise and fall eight feet, owing to changes of temperature. The anchorages would be half as large as the capitol at Washington, and each would contain fifty per cent more masonry than the largest of the Egyptian pyramids. The cables would be four feet in diameter (the Brooklyn Bridge cables are fifteen inches), and the towers would be 500 feet high. The bridge proper would accommodate ten railway tracks. Foot passengers would be lifted up to its level by elevators in the anchorages, but if it was desired to provide for the passage of vehicles, they would have to ascend the Palisades to reach its level.

COMPULSORY automatic car coupling is the subject of a bill presented to Congress by Representative Flower, of New York. The bill recites that, in view of the numerous accidents and loss of life resulting from the present system of coupling railway cars by hand, a bill requiring all railway companies to equip their freight and passenger trains with automatic couplers has become a necessity. The act is to be operative after November 1, 1892. The Interstate Commerce Committee may in special cases extend the time one year longer. Failure to comply with the provisions of the act subjects the offenders in each case to a fine of $500.

THE production of cyanogen directly from atmospheric nitrogen has been made the subject of further investigation by F. Breneman (*Jour. Am. Chem. Soc.*), which leads to the conclusion that while cyanides and ammonia may be thus produced experimentally, there are as yet insuperable difficulties in the way of adapting those methods to industrial purposes.

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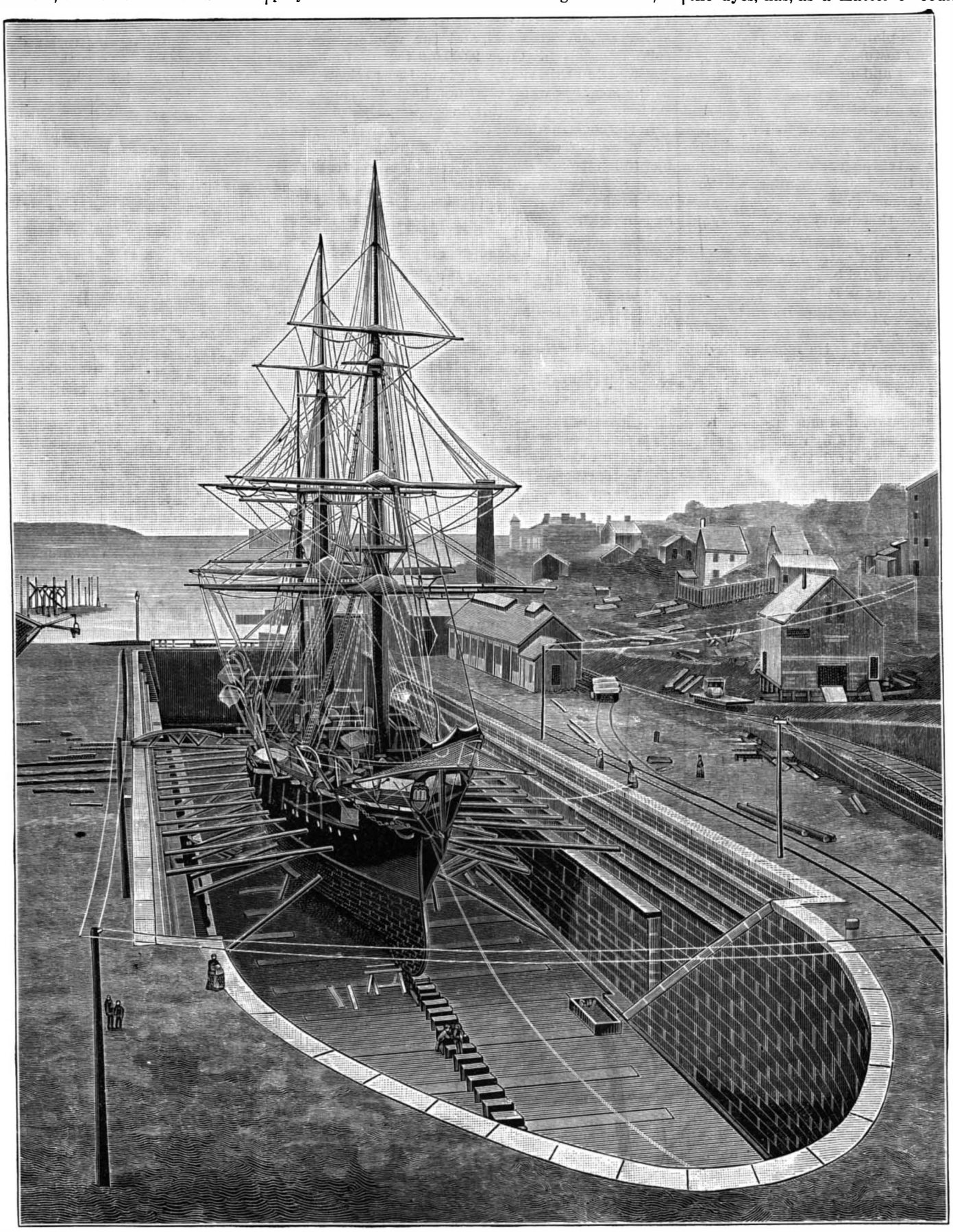
THE NEW DRY DOCK AT HALIFAX.

The engraving represents the dry dock lately opened at Halifax, Nova Scotia. This dock is capable of admitting any vessel in the world, and is the largest on the American continent. The dimensions are: Length 601 feet, width at top 102 feet, width at bottom 70 feet, depth of water over sill 30 feet, width of entrance 89 feet 3 inches. The entrance is closed by a ship caisson 92 feet 7 inches long over stems, 35 feet 6 inches deep from keel to platform, and 23 feet wide amidships. The engineers were Messrs. Bateman, Parsons & Bateman. The contractors were Messrs. Pearson & Son, Westminster, with whom was associated Mr. S. M. Brookfield, of Halifax. The harbor is never blocked with ice, and is remarkably well situated for a repair port.

Our engraving, which shows H. M. S. Canada in the dock, was prepared by *Engineering* from a photograph.



THE NEW DRY DOCK AT HALIFAX, NOVA SCOTIA.

Phosphorus.

At a recent meeting of the Edinburgh section of the Society of Chemical Industry, Dr. J. B. Readman read a paper on "The Manufacture of Phosphorus." At the outset he gave a short sketch of the earlier methods of manufacture. For about a hundred years bone ash had been used as a source of phosphorus, but now native mineral phosphate of lime had taken the place of bone ash in the estimation of the phosphorus manufacturer, owing, no doubt, to the low price at which it could be obtained. From one or other of the phosphates of lime phosphoric acid was prepared. This phosphoric acid was treated in an evaporator until it precipitated its lime. It was then mixed with carbonaceous matter to the extent of 25 per cent. The mixture was desiccated in a retort, and stowed away for distillation. Distillation was effected in small bottle-shaped retorts, and the crude phosphorus which was produced was mahogany brown in color. This crude substance was refined by redistillation, or by being treated with sulphuric acid. At the close of his paper Dr. Readman showed how little phosphorus was used in the manufacture of matches by giving the analysis of the amounts in a number of boxes by various manufacturers which had been tested. In these the quantity varied from half a grain to two and a half grains per box.

Eikonogen Developer for Traveling.

Distilled water which has been boiled and allowed to cool, 100 parts; sulphate of soda, 40 parts. Dissolve and add: Crystallized eikonogen, 10 parts; caustic potash, 10 parts. Cork well. For use, dilute with from three to ten times its volume of water. At the Photographic Society of Great Britain, Mr. Warnerke strongly recommended this for short exposures and dull days.

Abrus Precatoria.

At a recent meeting of the Society of Naturalists of Dorpat, Professor Kobert (*Wiener Medizinische Blatter*, November 7, 1889) presented an account of a new poison, of an albuminous nature, which he had extracted from the seeds of the *Abrus precatoria*—a plant already known for hundreds of years. These seeds occur in the form of red bodies, about the size of a pea, with a black spot on them, and are spoken of in the Indies as "chicken eyes," while in Germany they are described as "paternoster-erbsen," from whence the attribute "precatoria" originates. As a remedy, the *Abrus precatoria* seeds have been for a long time employed as irritants and anti-hemorrhage remedies; in India they are frequently employed for poisoning, while in Brazil they are used in the treatment of ophthalmia.

In India the seeds are rubbed up in their fresh condition, and then rolled up into a fine roll, whose sharp point stuck into the skin is sufficient to kill any man or animal, and leaves no more mark than the sting of an insect. It is stated that entire English colonies have been murdered in India in this manner. Professor Kobert has examined the albuminous constituent, and has found that it is one hundred times more poisonous than strychnine, and is similar in its action to the poison which may be extracted from castor oil seeds. Like all other albuminous poisons, it loses its activity when boiled, and consequently the *Abrus precatoria* seeds may be even used as food. Dr. Kobert has found that death is caused, when this poison is introduced into the blood, through the coagulation of the blood corpuscles.—*Ther. Gazette.*

Wood as a Source of Human Food.

Probably no modern science presents a wider field for speculation than that of chemistry, and more especially, perhaps, that branch of the science which treats of organic compounds. Since the day when Wohler overthrew forever the notion that organic substances were exclusively the products of the operation of a so-called vital force by his discovery of the synthesis of urea, a great number of bodies, hitherto obtained only in Nature's laboratory, have been successfully built up, as the result of a careful and most minute study of their exact nature. The discovery of the preparation of substances by artifice, more particularly the dyes, has, as a matter of course, influenced very considerably home and foreign industries. What shall be said, then, when chemistry promises to solve hard problems of political and social economy? In an address delivered at Heidelberg, by no less eminent an authority than Victor Meyer, it is announced that "we may reasonably hope that chemistry will teach us to make the fiber of wood a source of human food." What an enormous stock of food, then, will be found, if this becomes possible, in the wood of our forests, or even in grass and straw.

The fiber of wood consists essentially of cellulin, $C_6H_{10}O_5$. Can this be made to change into starch? Starch has exactly the same percentage composition, but, as every one knows, it differs very much in its properties, and the nature of its molecule is probably much more complex. Cellulin is of little or no dietetic value, and it is not altered, like starch, in boiling water. It readily gives glucose when treated with strong sulphuric acid, as is easily shown when cotton wool, which is practically pure cellulin, is merely immersed in it. Starch gives the same product when boiled with weak acid. The author further quotes the researches of Hellreigel, which go to show beyond dispute that certain plants transform atmospheric nitrogen into albumen, and that this process can be improved by suitable treatment. The production, therefore, of starch from cellulin, together with the enforced increase of albumen in plants, would, he adds, in reality signify the abolition of the bread question. It must be borne in mind, however, that theory, fascinating and promising though it may be, is not always capable of being followed up by a practical result.—*Lancet.*

Crystallography.

If sodium sulphate be allowed to crystallize (*New Idea*) between plates of unglazed porcelain in the open air, and if the crystallization be reproduced two or three times by sprinkling with water, the plates fall to powder. The same phenomenon is observed with very hard stones. This crystallization may be the cause of the comminution of rocks which resist water.

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Patent Legislation.

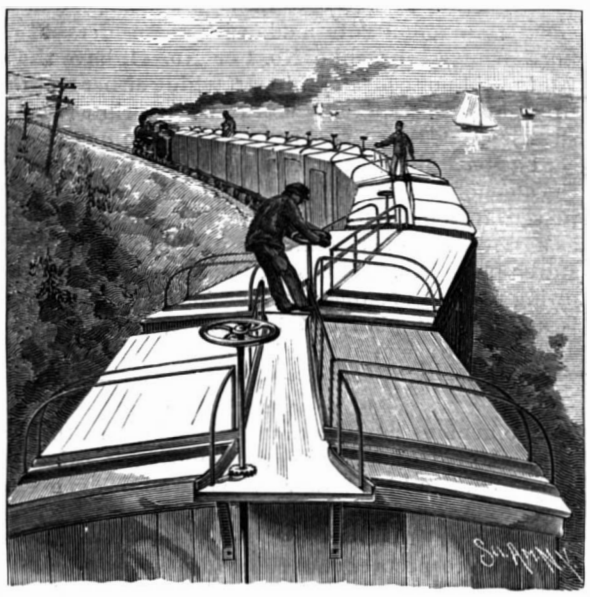
The *Engineer* thinks it would interest the public to know what manner of men they are who are always for tinkering the patent laws. There doubtless never was anything made by man that could not be improved by some other man, but it is good sometimes to let well enough alone, and it is difficult to see wherein the present patent laws could be improved.

Among a number of bills relating to patents, one proposes to change the lifetime of them from seventeen to seven years, and another provides that any patent hereafter issued may be canceled by special act and the payment to the inventor of not less than $50,000 nor more than $100,000, with authority for Congress to grant a further allowance to the inventor of the amount expended by him in perfecting his invention.

The *Engineer* proposes a bill which provides that the income of any person tinkering with the patent laws shall be permanently cut off, and he be confined in a lunatic asylum for life.

A RUNNING-BOARD FOR THE TOP OF CARS.

The illustration herewith represents a construction designed to prevent a brakeman or conductor from falling off the cars when operating the brakes from the top of a car, and also provides a running-board on each car adapted to closely approach a similar board on an opposing car, affording safe passage from one car to the other. This invention has been patented by Mr. Francis W. Pool, of No. 57 East Tenth Street, St. Paul, Minn. The board, at each end of the car, has projecting extremities wider than the body portion, to afford an easy and safe footing, these ends being stayed or strengthened by suitable brackets, and at the sides of the board are uprights supporting guard rails extending from end to end of the car. There is also a skirting rail near the bottom, so that the feet of one on the board will not be liable to slip outward. A transverse gangway of similar construction is likewise provided for at each end of the car, to intersect with the running-board.

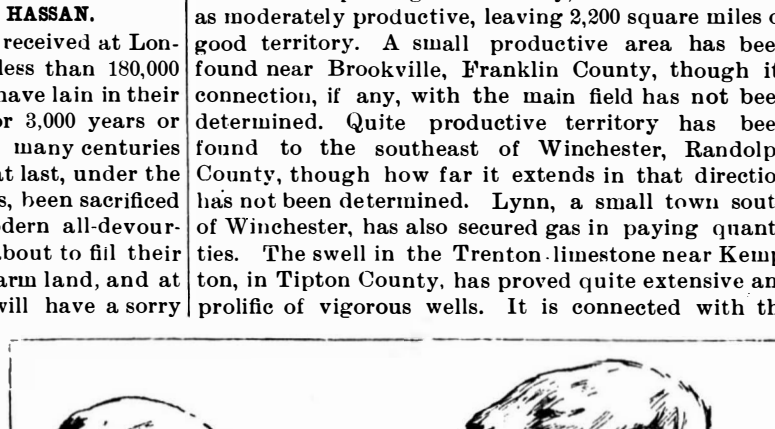


POOL'S RUNNING-BOARD FOR CARS.

THE MUMMY CATS OF BENI HASSAN.

A curious consignment of goods was received at London a few weeks ago, consisting of no less than 180,000 mummy cats from Egypt. These cats have lain in their sacred burial place at Beni Hassan for 3,000 years or more, and after having fulfilled for so many centuries the destiny intended for them, have at last, under the impulse of nineteenth century progress, been sacrificed upon the altar of "utility"—that modern all-devouring ogre. These mummies are now about to fil their final function of fertilizing English farm land, and at the future resurrection poor pussy will have a sorry time trying to gather together her scattered bones.

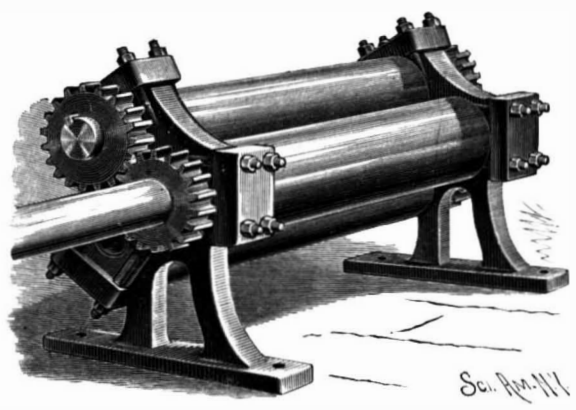
We give sketches of four of the heads of these extraordinary objects, for which we are indebted to that new and energetic newspaper the London *Daily Graphic*. The English farmers are indebted for this excellent lot of twenty tons of manure to the lucky accident which befell an Egyptian who, while digging, fell into a pit which proved to be a subterranean cave completely filled with mummy cats, each one being separately embalmed and wrapped up after the usual fashion of Egyptian mummies. Pussy of B.C. 2000 was a sacred object to a section of the ancient Egyptians, and when a cat died—as even a cat eventually must—it was buried with as much honor as any human being. The finder having reported his discovery, laborers were soon at work, and turned out tens of thousands of the mummies. Some were taken by the farmers of the place, others went to a merchant in Alexandria, who shipped them to Liverpool, where another merchant, a local fertilizer, bought the consignment at £3 13s. 9d. a ton. The auctioneer, adding insult to injury, knocked down the lot of 180,000 cats with the head of one of them as a hammer. To such base uses have the gods of Egypt come!



MUMMY CATS RECENTLY DISCOVERED IN EGYPT.

AN IMPROVED CANE MILL.

The accompanying illustration represents a roller cane mill designed to obviate the use of the bridge or



HATTON'S CANE MILL.

knife placed between the two lower rollers of the ordinary mill, and to relieve the main frame of the mill from pressure and danger of breakage. The invention has been patented by Mr. Joseph E. Hatton. The check frames are merely supports for the rollers, and the main top roller stands immediately above the lower or bagasse roller, while the front or cane roller is so arranged that its axis is on a line with the meeting surfaces of the other two rollers. In this way the second bite or crushing action is at a lower level than the first bite, the partially crushed cane dropping naturally upon the surface of the lower roller, and being carried over it without the use of a knife. To take the strain of the rollers, four resistance frames or yokes are employed, one on each side of each of the cheek frames, these yokes being each formed with journal spaces arranged obliquely to each other, so that the journal spaces of the yokes coincide with the spaces of the cheek frames. The journal blocks for the shafts or gudgeons of the rollers are placed in the bearing spaces of the cheek pieces and resistance yokes, and upon each block is an adjusting plate, these plates having no connection with the cheek pieces, but only with the resistance yokes, which take the entire strain of the rollers, the cheek pieces acting as mere supports and not as working elements of the machine. In case of breakage, the yokes are easily and cheaply replaced.

For further information relative to this invention address Mr. J. E. Hatton, care of Messrs. Hatton & Macias, St. Domingo City, Island of St. Domingo, West Indies.

Indiana Gas Lands.

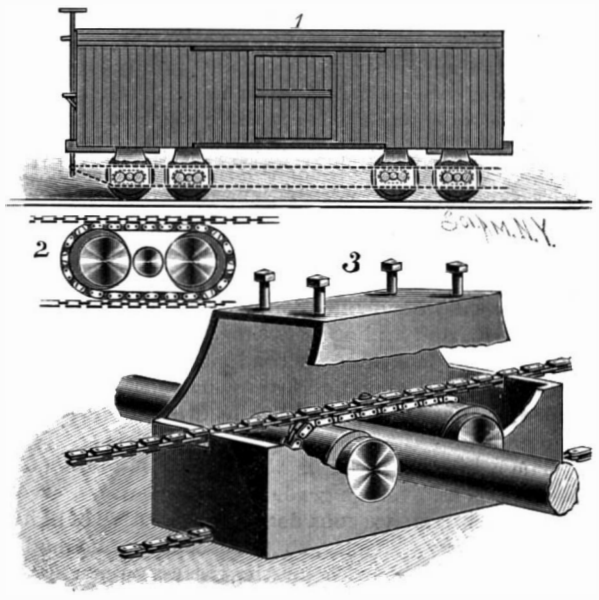
The number of square miles of productive territory in Indiana, where gas is found in paying quantities, is about 2,500. Of this 2,500, probably 300 square miles, the southern prolongation mostly, must be considered as moderately productive, leaving 2,200 square miles of good territory. A small productive area has been found near Brookville, Franklin County, though its connection, if any, with the main field has not been determined. Quite productive territory has been found to the southeast of Winchester, Randolph County, though how far it extends in that direction has not been determined. Lynn, a small town south of Winchester, has also secured gas in paying quantities. The swell in the Trenton limestone near Kempton, in Tipton County, has proved quite extensive and prolific of vigorous wells. It is connected with the main field between Tipton and Kokomo, near Sharpsville. Whether it is continuous with the productive area at Sheridan and that north of Noblesville has not been determined as yet. Small areas have been discovered at Eagletown and Carmel, in the southwestern part of Hamilton County.—*L., H. and Power.*

A Water Route from Alabama to Pittsburg.

A Sheffield (Ala.) dispatch, February 17, says: Sheffield to-day celebrated the first shipment of iron from Alabama to Pittsburg by barges on the Tennessee and Ohio rivers. The present shipment is 5,000 tons, taken by nine barges, which are towed by the steamer Percy Kelsey. The rate of freight is $2.50 per ton, which is so much less than the rate by rail that it affects the iron trade of the whole country. It is expected that arrangements will at once be made to market the entire product of Sheffield's five furnaces by this route.

AN IMPROVED CAR BRAKE.

The accompanying illustration represents a car brake in which the brake is arranged to be applied directly to the axle instead of the wheel tread. The invention has been patented by Mr. William Brunquest, of Menominee, Mich. Fig. 1 is a side view of a car provided with such a brake, Fig. 2 being a sectional and Fig. 3 a perspective view, showing the brake mechanism. In a casing arranged for connection with the car floor are bearings in which are mounted rollers with eccentric faces, between which the car axle passes, there being arranged in connection with the rollers an endless chain or belt engaging teeth in the peripheral face of the rollers. All of the chains or belts of the several eccentric rollers are connected by an operating chain with the brake staff, by revolving which the rollers will be turned to bear hard upon the axles, to check their rotation. To throw the eccentric faces of the rollers out of engagement with the axles, a second



BRUNQUEST'S CAR BRAKE.

chain is employed, running on the opposite side of the rollers, and also connected with the brake staff, by turning which in an opposite direction the axles will be freed from the pressure of the eccentrics.

Proposed Swiss Mountain Railway.

A project for a railway to the summit of the Jungfrau, which rises to a height of about 13,670 ft., has latterly assumed a more tangible shape. Two designs have been proposed, one by Mr. Moritz Kochlin, at one time connected with the building of the Eiffel tower, and the other by Mr. Trautweiler, engineer of the St. Gothard and Brunig railways. The first is understood to have received the most favorable consideration. The mountain line proper will be about 3¼ miles long This section is to be built either on the rack system of the Mount Pilatus Railway or it is to be divided into five sections of cable line worked by water power. At the end of each of the sections the passengers will be transferred to a car on the succeeding section. A reservoir on the summit of the mountain, supplied by a series of pumps at different levels, is to furnish the required water power. Mr. Trautweiler's design provides for an underground line over the whole mountain section, thus seeking to avoid climatic difficulties. There are to be four sections of a large pipe conduit, and the power is to be furnished by means of a cable. To drive this compressed air is to be used instead of water power. Mr. Kochlin's estimate of the cost of building the line is 390,000*l.*, while Mr. Trautweiler's estimate foots up to 230,000*l.*

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The Manitou and Pike's Peak Cogwheel Railway.

FRED. R. HASTINGS.

On the 24th day of last September a faint blast reverberating down the rocky sides of Pike's Peak announced to the world that the "Peak Railroad" was no longer a fancy, but a fact. Eight hundred men and one hundred and twenty teams of horses and mules were set at the work of constructing the roadbed. All provisions, tools, and camping outfits were transported to the camps along the line on the backs of mules and burros by trail. None but those familiar with the Rocky Mountain region can form an adequate conception of the enormity of the work. The precipitous cliffs of solid granite, the deep canons and ravines, the snow fields of great depth, seem obstacles set by nature never to be surmounted by man. Yet to-day the roadbed is completed, except one mile of the line on the summit, which will be left until after the spring thaws. The work was commenced near the summit in the fall and continued downward, so as to escape the great severity of the winter in such an altitude.

The road will be operated by the Abt cogwheel system, and will be the only road in America of that system. The roadbed is 15 feet wide, increased to 20 feet through cuts, thus giving protection, in case of derailment, from more serious accident. There is to be no trestle work on the entire line, and all bridges will be constructed of iron. The culverts will be built of solid masonry, and placed wherever necessary to guard against washouts.

The track will be of standard T-rails, standard gauge, and laid on red spruce ties. The rack rail, laid in the center between the rails, will weigh 110 pounds to the foot and be laid in short sections, of which the cogs or teeth are cut with great precision.

The engines, built by the Baldwin Locomotive Works, will weigh about 35 tons, and be operated by cogwheels alone, there being no adhesion drivers, which are so placed as to gain every advantage from the weight of the engine. The double set of pinion brakes that work in the cogs can stop the train in ten inches, going either way, on any grade, and at the maximum speed, eight miles an hour. The engines will be powerful enough to carry three coaches.

The cars, built in Springfield, Mass., are designed to sit low, within 18 inches of the rails, and are not tilted with the grade, but built on the trucks, so as to bring the coaches level. The cars are not drawn, but pushed by the engine. One hundred and fifty people will constitute a train load. The trip from Manitou to the summit will take an hour and forty-five minutes; the down trip, half an hour less time.

The entire length of the road is somewhat over nine miles, and the elevation overcome between Manitou and the summit is about 8,000 feet, nearly 1,000 feet to the mile.

The maximum grade is 25 per cent, minimum 8 per cent, with an average grade of 17 per cent.

The company are considering the question of lighting the road by electricity, so the ascent can be made by night, and the sunrise be witnessed by passengers in the morning on the summit.

The road will be completed, in all probability, by next June, and will then represent more than half a million dollars.

A fuller, illustrated article will appear at a later date, on the road.

It may be of interest to note the following list of the cogwheel lines of the world:

Location.	When built.	Ascent.
Mount Washington	1866–69	1 ft. in 2·67 ft.
Vitznau-Riga	1870	1 " 4 "
Kahlenberg-Vienna	1872	1 " 10 "
Schwahenberg-Pesth	1872	1 " 10 "
Arth-Riga	1874	1 " 4·8 "
Rio de Janeiro	1882	1 " 6·6 "
Drachenfels to Rhine	1883	1 " 4·5 "
Pike's Peak and Manitou	1890	1 " 4 "

Improved Treatment of Ores.

BY E. B. PARNELL.

The quartz or other ore is first heated to a fair red heat in a suitable furnace, and then immersed in its heated state in water. The result is that the ore becomes so softened that it can be crushed by rollers with great ease. A form of apparatus that may be employed to heat the ore consists of a horizontal tube, through which the ore is propelled by a helical revolving screw mounted upon a hollow shaft. Into this tube, through perforations in the hollow shaft, is drawn air which has been previously heated by any suitable furnace. At the time the ore reaches the end of the tube it becomes sufficiently heated by the air, and is discharged into a tank of water. The ore is next raised by an elevator to a second tube, which is similarly constructed to the first, and has passed through it the air proceeding from the first, for the purpose of drying the ore. The ore is delivered from the last tube into the hopper of the rolling or other machine. Instead of discharging the ore from the first tube into a tank of water as above described, the ore may be discharged on to an endless band, which would carry the ore under a shower of water and into a suitably constructed oven before finally dropping it into the hopper of the rolling mill.

Paste and Glue.

In the *Photographic Times* Mr. W. H. Gardner collects together a number of formulæ of various mountants, of which we give the following:

GELATINE MOUNTANT (NO. 1).

Cooking gelatine	1 ounce.
Alcohol, 95 per cent	10 ounces.
Glycerine	½ to 1 ounce.

Soak gelatine in cold water for an hour or more, take out and drain off all the water which will go, add to alcohol in wide mouthed bottle. Add one-half to one ounce of glycerine, according as gelatine is of a hard or soft kind. Put bottle in hot water, with occasional shaking until gelatine is quite dissolved. Will keep indefinitely, and has only to be heated up when wanted for use.

ANOTHER (NO. 2).

Nelson's No. 1 photographic gelatine	4 ounces.
Water	16 "
Glycerine	1 ounce.
Alcohol	5 ounces.

Dissolve the gelatine in the water, then add the glycerine, and lastly the alcohol.

PERMANENT PASTE (NO. 3).

Arrowroot	10 parts.
Water	100 "
Gelatine	1 part.
Alcohol	10 parts.

Soak gelatine in the water, add the arrowroot which has first been thoroughly mixed with a small quantity of the water, and boil four or five minutes. After cooling add the alcohol and a few drops of carbolic acid.

ANOTHER (NO. 4).

Best Bermuda arrowroot	1¾ ounces.
Sheet gelatine or best Russian glue	80 grains.
Water	15 ounces.
Methylated spirit	1 ounce.

Put the arrowroot into a small pan, add one ounce of water, and mix it thoroughly up with a spoon, or the ordinary mounting brush, until it is like thick cream; then add fourteen ounces of water and the gelatine broken into small fragments. Boil for four or five minutes, set it aside until partially cold, then add the methylated spirit and six drops of pure carbolic acid. Be very particular to add the spirit in a gentle stream, stirring rapidly all the time. Keep it in a corked stock bottle, and take out as much as may be required for the time, and work it up nicely with the brush.

STARCH PASTE (NO. 5).

Pour cold water on good laundry starch to barely moisten it. Then stir in *boiling* water until proper consistency is reached. Squeeze through canvas if not free from lumps. Starch paste should be freshly made for each batch of prints.

ANOTHER (NO. 6).

Allow four parts by weight of hard gelatine to soften in fifteen parts of water for several hours, and then moderately heat until the solution is quite clear, when 65 parts of boiling water should be added while stirring. Stir in another vessel 30 parts of starch paste with 20 of cold water, so that a thin milky fluid is obtained without lumps. Into this the boiling gelatine solution should be poured while constantly stirring, and the whole kept at a boiling temperature. When cool, add to the whole ten drops of carbolic acid to prevent souring. This makes a very tenacious paste.

CASEIN MUCILAGE (NO. 7).

Heat milk with a little tartaric acid, whereby casein is separated. Treat the latter while still moist with a solution of six parts of borax to one hundred of water, and warm gently while stirring, which will cause the casein to be dissolved. Of the borax solution enough should be used to leave only a little undissolved casein behind.

GOOD MOUNTING PASTE (NO. 8).

Add to 250 c. cm. of concentrated gum solution (2 parts gum to 5 water) a solution of one gramme sulphate alumina in 20 c. cm. water. (Alum does not answer the purpose as well.) The addition of the sulphate is effective, in that this gum is not so readily softened by moisture, and, besides, wood can be fastened to wood by means of it. Its adhesive qualities are, in general, greater than those of pure gum arabic.

IMPERVIOUS PASTE (NO. 9).

Soak ordinary glue in water until it softens, remove it before it has lost its original shape, and dissolve in ordinary linseed oil on a gentle fire until it acquires the consistency of a jelly. This paste may now be used for all kinds of substances, as, besides strength and hardness, it possesses also the advantage of resisting the action of water.

THIN MUCILAGE (NO. 10).

A paste that will not draw engravings when pasted down on paper must be thin. A mixture of equal parts of gum tragacanth and gum arabic forms with water a thinner mucilage than either one alone.

LIQUID GLUE (NO. 11).

With any desired quantity of glue use ordinary whisky instead of water. Break the glue in small fragments and introduce these into a suitable glass vessel, and pour the whisky over them. *Cork tightly*, and set aside for three or four days, when it will be ready for use. The whisky must not be too strong, and a little heat is generally required.

ANOTHER (NO. 12).

Same as above, except that acetic acid is used in place of whisky, and that the bottle containing ingredients must be placed in hot water to dissolve the glue.

ANOTHER (NO. 13).

Glue	8 ounces.
Water	8 "
Nitric acid	2½ "

Dissolve the glue in the water by immersing vessel containing same in hot water. When solution is effected, add the acid. Effervescence will take place with the evolution of orange nitrous fumes. Now cool. It should be kept in a well stoppered bottle, and will remain permanently liquid.

As regards the formulæ collected by Mr. Gardner, we may remark, says the *Photo. Review*, that of the above Nos. 13, 12, and 9 are quite unfit for mounting silver prints, although they may be useful for other work in the studio; Nos. 12 and 13 for cardboard and light woodwork, where the presence of acid is not likely to be detrimental; and No. 9 (which is really an emulsion of glue and linseed oil, and requires well beating together) for cementing articles likely to be exposed to damp. Strips of cloth used to make the developing room light-tight may well be cemented with No. 9, especially if ten grains of finely powdered bichromate of potash be stirred into each ounce just before use.

The desirability of employing Nos. 7 and 8 as mountants for silver prints is open to doubt, although these are excellent for cementing all such ordinary materials as come under the denomination of "stationery."

We thus have left adhesives Nos. 1, 2, 3, 4, 5, 6, and 10 as quite safe for silver prints if good materials are used, and do not become decomposed subsequently. Gelatinous mountants made with a considerable proportion of alcohol, like No. 1 or No. 11, have the advantage of not considerably stretching either mount or print, and are especially useful when prints (whether silver or Woodburytype) have to be mounted on thin card as book illustrations. In the case of Nos. 2, 3, 4, the alcohol is used mainly as an antiseptic, and is not present in sufficient quantity to have much influence as a preventive of stretching or cockling. The simple starch paste, No. 5, is not satisfactory in all instances, owing to want of sufficient adhesion, in which case it is an excellent plan to adopt No. 6, in which starch and gelatine are used together.

An Oil Gas Lamp.

An ingenious modification of the oil gas method has been adapted by Mr. Gilbert Robinson, of Elland, in the design of a high power lamp of the Lucigen class, for outdoor purposes. The object of this new variety of the order of lamps that have seriously interfered with the prospects of the electric arc lamp for a variety of purposes, is the abolition of all outside mechanical appliances for generating the light. Pressure is required, of course, and this is obtained by confining the gas produced from a portion of the liquid hydrocarbon combustible exposed to the heat of the flame for this purpose. The lamp is thus made independent of pumping, air-compressing machinery, etc., and only needs to be started by making the burner hot with the flame of a handful of oily waste burnt in a receptacle provided for the purpose. The oil is then turned on, and the lamp works automatically until the reservoir is emptied. This simplicity of principle permits of simplicity of design. The gas-making portion of the lamp comprises a tube in which the oil is exposed to the heat of the flame. When the gas is made, it is divided into two currents—one going into the top of the reservoir, to force the oil out into the carbonizing tube; the other going to the jet, whence it issues, after a few minutes' working, at a pressure of 20 lb. It is thus oil gas that is burnt; and the maker calculates that by this means a light of 3,000 candles can be obtained at a cost of 2d. to 3d. per hour, according to the facilities for obtaining the common oil required.

Scratching the Back for Intermittent Fever.

Dr. Alois Fenykovy communicates to a Vienna medical journal an account of some observations made on the treatment of intermittent fever by means of friction of the back along the spine. Many years ago, as stated in the *Lancet*, while at Nisch with his regiment, there occurred so many cases of intermittent fever that the stock of quinine was becoming exhausted, and, in order that the patients might not be entirely without some sort of treatment, it was ordered that they should be rubbed twice a day along the spine with simple ointment. The day after this order had been given, it appeared that the usual attack had not come on. Accordingly, since that time Dr. Fenykovy has very frequently employed this treatment, and usually with marked success. Indeed, he says that three-fourths of his cases have done very well without any quinine at all.

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RECENTLY PATENTED INVENTIONS.

Engineering.

COMPOUND ENGINE. — John Riekie, Lahore, India. This engine has two high pressure cylinders and a low pressure cylinder arranged between them, a port leading from the steam chest to each high pressure cylinder, and two ports leading to the low pressure cylinder, with various novel features, the design being to exert equal power on the crank arms at all grades of expansion, and have the compounding on each crank separately.

Electrical.

LAMP ADAPTER.—James Stewart, New York City. This adapter is formed of a button of insulating material surrounded by a screw-threaded peripheral band, a ring being embedded in the button and connected electrically with the band, while a central stud is provided with a contact piece, in order that lamps of different kinds may be adapted to lamp sockets not made for them.

Mechanical.

TRANSMITTING MOTION. — John N. Severance, Boston, Mass. This invention covers a device for transmitting motion to rotary shafts, and for stopping the some positively in a given position, automatically at each revolution, when necessary or when desired by the operator, the stop motion being of great strength and durability, and the device being applicable to all kinds of machinery requiring alternate periods of motion and of rest.

PIPE CUTTER. — Timothy Byrne, Bloomington, Ill. This a machine specially designed for cutting pipes from the inside, where the exterior face of the pipe cannot be conveniently reached, and has a frame with a slotted hub, a cutter carrier formed of two sections held togther by springs and having a conical aperture, while a feed screw with a conical end projects into the conical aperture of the carrier.

Agricultural.

HAY RAKE.—Henry L. Banta, Canon City, Cal. This is a rake which can be used either as a self-dumping or a hand dumping rake, and each tooth is so arranged in connection with a spring that the teeth will be allowed to spring up over stones and other slight obstructions and will then be pressed down again in contact with the ground.

HARVESTER REEL.—Ludvig Peterson, Arlington, South Dakota. This invention covers an attachment comprising a ratchet wheel secured on the shaft of the reel and a spring fastened at one end to a lever for adjusting the reel, and at its other end engaging the teeth of the ratchet wheel, to prevent the reel from turning backward and throwing the grain into confusion on the platform or over toward the cutting machine.

CULTIVATOR. — Frank A. Ruggles, Three Rivers, Mass. Combined with a slotted frame are slotted arms secured to opposite sides of the frame, and a series of cutting disks mounted in the arms, making a hand implement especially adapted for garden use, and which may be used as a weed cutter or a weed cutter and cultivator combined.

Miscellaneous.

TURNING TELEGRAPH PINS.—William W. McNeal, Stockton, N. J. Combined with revolving cutters and a traveling endless belt are revolving arms carrying center pins and mandrels, the latter revolved by the belt when the blocks carried by them and the center pins approach the cutters, making a simple machine designed to turn out a large number of pins in a short time.

CIGARETTE MACHINE.—Louis Josselin, New Orleans, La. This is a machine of a width equal to the length of two or more cigarettes, and is designed to quickly roll and seal the tobacco in the wrapper, and cut the cigarettes to the proper size, the invention covering various novel details and combinations of parts.

COIN OPERATED MACHINE. — Peter Schneider, Brooklyn, N. Y. This machine has a coin chute and a tripping mechanism connected with a mechanism for automatically delivering one cigar at a time, so that when a particular coin is deposited, the device may be operated by hand to release the cigar, deposit the coin, and relock the cigar delivery mechanism, for automatic cigar selling.

EXPLOSIVE STAFF.—William L. Heiskell, Indianapolis, Ind., and Francis E. Drake, Columbus, Ohio. This is a device adapted for employment in connection with theatricals and tableaux, etc., providing a staff carrying a trident or spear, with a firing attachment for exploding cartridges, so that the flash may be rendered visible if desired.

EDUCATIONAL APPLIANCE.—Franklin E. Meyers, Garrett, Pa. This is a movable figure arithmetical chart to facilitate the teaching of addition, and consists of a framing with figured slats adjustable longitudinally, whereby the figures at one end of each of the slats may be brought successively into register with each of the figures on the other slats, the construction being readily taken down and packed in small space for storage or transportation.

PENCIL SHARPENER. — Frank Dunworth, New York City. This invention consists of a staple-shaped knife adapted for insertion in the edge of a slate frame or desk, and having a downwardly inclined bow section with a lower cutting edge, whereby a slate or lead pencil may be sharpened by being drawn in contact with the device.

PHOTO NEGATIVE BATH DISH.—John R. Moeller, Grand Island, Neb. This is a dish with vertical end and side ribs, integral transverse ledges at the lower end of the end ribs, and a corrugated partition, to support a number of negatives in a single dish so that they will not bear against each other, while their lower edges will be held above the sediment in the bath.

DRAUGHT EQUALIZER. — John L. Powles, Goodland, Ind. This improvement is more especially designed for grain harvesters or binders, three horses taking the draught from the inside next the standing grain and the other horse on the opposite side of the pole taking the draught from the outside, the invention being an improvement on former patented inventions of the same inventor.

SELF-OILING AXLE BEARING.—James S. Patten, Baltimore, Md. This bearing is especially designed for all kinds of vehicles, and consists of an axle having a sliding rod working in a groove in the face of the axle and projecting through the shoulder at the end of the bearing surface of the axle to an oil chamber, the rod being connected with a cam groove in the face of the axle box to pump the oil from its chamber and diffuse it over the face of the axle bearing.

BALING PRESS. — Andreas Mattijetz, Giddings, Texas. The construction of this press is such that at each reciprocation of the plunger at one side in the follower chamber for the introduction of the material to be baled, which is held from any retrograde movement, while the size of the baling chamber is adjustable, and the press and the power employed in connection with it are readily transportable.

COILED WIRE BRUSH. — John B. Christoffel, Brooklyn, N. Y. This is a flexible brush for cleaning flues, tubes, etc., and consists of two or more twisted wires and one or more spring wires coiled around the twisted wires in spiral shape to form a cylindrical brush with tapering ends, the invention being an improvement on a former patented invention of the same inventor.

WELL BORING APPARATUS.—Lawrence V. Elder, New Orleans, La. This invention consists in providing the well pipe with a temporary coupling device for the successive sections longitudinally movable on the pipe from one section to the other without the necessity of removing the coupler, whereby the sections may be added more expeditiously.

ROCK DRILLING MACHINE. — Jacob Irgens, Palisade, South Dakota. This is a machine adapted to be operated by hand or other power, having a rotary shaft mounted in a vertically adjustable carriage in a frame, an arm on one end of the shaft, hammers pivoted to the arm, a frame supported from the carriage carrying the drilling tool, and other novel features, designed to afford a simple, durable, and very effective machine.

MEANS FOR PROPELLING VESSELS.—Abraham Heuman, New York City. The main crank shaft is connected to a shaft journaled athwart midships on which is a walking beam, the latter shaft carrying side wheels, and to this shaft are geared two parallel propeller shafts carrying screws at the rear of the vessel, which is thus provided with both systems of propulsion, to make possible a very high speed.

LUMBER KILN.—Andrew T. Anderson, Trinity, Texas. This is a kiln constructed with special reference to the combustion of cinders or sparks, to prevent their escape into the chamber containing the lumber, the fuel chamber having small perforations for the passage of products of combustion, above which is a primary combustion chamber, adjacent to which is a final combustion chamber having exits near its base through which the heat passes to the drying chamber.

FURNITURE POLISH.—James M. Hall, Curtis Morris, and Willie S. Hamilton, Ritchie Court House, West Va. This is a polish containing certain proportions of different ingredients designed to equal a fine varnish in important particulars, yet cheaper and capable of drying quickly, and of resisting extremes of temperature without blistering or cracking, there being among the ingredients linseed oil, turpentine, copal varnish, alcohol, muriatic acid, olive oil, etc., in proportions specified.

HAT HANGER.—Joseph Massey, Faribault, Minn. This hanger consists of a thin metal strip having suitable supports beneath the sweat band, and extending from end to end or side to side, following the crown, with a spring-actuated hanger pivoted thereto, its end having a spring or loop, the device supporting the crown and preventing it from being dented.

SUSPENDER.—Jacob Katzenberg, New York City. This is a combined suspender and shoulder brace, and has a back heart piece with two suspender ends and four buckles and loop, with shoulder straps and their front suspender ends, with straps to go under the arms, transverse straps, and an adjustable vertical strap.

SHOE LACER. — Abner C. James, Pomona, Cal. This lacer has a stop and a tip at its respective ends, with a flexible metallic strand incorporated in the lace between its tip and middle portion, the metal strand being of a length to be bent back and forth in the hooks or eyelets of a shoe.

WASH BOILER. — Lyman I. Burbank and Charles Nippert, Ashland, Wis. This invention is an improvement in that class of boilers which have a perforated false bottom with baffle plates which allow a circulation of water downwardly through them, the water after being heated rising through side passages and descending again through the clothes.

WASHING MACHINE. — Levi J. Montgomery and Clark P. Townsend, Broken Bow, Neb. This invention relates to an apparatus whereby clothes may be washed without mechanical rubbing or squeezing and in which circulating hot water and steam are utilized to insure a quick and thorough cleansing of the clothes without injuring them.

CLOTHES PIN. — Edmund H. Turner, Fergus Falls, Minn. This is a wire clothes pin formed of a single piece, having the end of the wire provided with interlocking eyes or rings, and having curved ends to slide upon the line, and downwardly and inwardly curved sides to clasp the clothes line and hold a garment thereon.

NEW BOOKS AND PUBLICATIONS.

THE WORKS OF WALTER BAGEHOT. With Memoirs by R. H. Hutton. Edited by Forrest Morgan. In five volumes. Pp. 458, 447, 450, 592, 678. Price $5. Hartford, Conn.: The Travelers Insurance Company.

The contents of the first two volumes of this most valuable work are classified thus: Literary Studies, including *National Review* essays; Religious and Metaphysical Essays, and Letters on the French Coup d'Etat, the latter being the best study extant of the accession of Louis Napoleon to the throne of the now defunct French empire. Next come a number of essays devoted largely to subjects of contemporaneous history as referred to the time they were written, which concern themselves with the political movements of England. The fourth volume includes his treatise on the English Constitution, two essays on Parliamentary Reform, and a series of chapters on "Physics and Politics," which title would be more appropriate to the subject, perhaps, were the first two words omitted. The fifth volume contains three works, "Lombard Street," "International Coinage," and "Depreciation of Silver." A very complete index covering 45 pages is an invaluable addition to the work. The range of subjects treated and the labor expended on them by the author make the work authoritative within its scope. To all who enjoy the detailed study of English literature, statesmanship, and political economy, these books may be confidently recommended. Its low price, it is to be hoped, will result in its introduction into many homes.

STEAM. By William Ripper. London and New York: Longmans, Green & Co. 1889. Pp. viii, 202. Price 80 cents.

The author, a well known authority, having given some lectures recently to an evening class of young mechanical engineers, has put his notes into the form of a book, and in it we find a very practical treatise on the steam engine, its mechanical construction, economic use of steam, combustion of fuel, and all other topics which, at the present day, have acquired such extensive study, and some of which, unfortunately, have not yet reached the limit of their development.

SCIENTIFIC AMERICAN BUILDING EDITION.

MARCH NUMBER.—(No. 53.)

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

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(1924) B. F. A. asks: In the magnetic telephone described page 374. vol. 67, how is the party at the other end of the line called, as there is no bell? A. A battery or magnetic call may be used.

(1925) A. La F. asks how to find the chord of a segment, given area of segment and the radius of the circle. A. The area of the segment is equal to the length of the arc in terms of the radius multiplied by ½ radius. This gives the length of arc. By dividing the length of arc by π (3·14159+) and multiplying by 360 we get the degrees of the arc, which may be carried out to minutes and seconds. From a table of circular functions we find the sine of half this arc. This function multiplied by 2 gives the chord.

(1926) W. B. H. asks: Is there anything I can apply to whitewash (contains no glue) to loosen it, so it can be scraped off the board lining of a building? A. A weak acid is the only thing we can suggest. Even then the remedy might be worse than the disease, as the boards would absorb much of the salt of lime produced.

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(1927) H. P. L. asks: What produces the letters that you may see by holding a sheet of foolscap to the light? A. The design is pressed in raised metal pattern upon the wet pulp before it sets. Sometimes the water marks are raised, sometimes depressed. They are due to unequal thickness of the paper in either case. 2. Give some authority which has the nearest practical perpetual motion machine explained. A. There is no "nearest practical perpetual motion machine." We refer you, for the history of attempts to produce perpetual motion, to Dirck's "Perpetual Motion," $10. We have some copies, but the work is out of print.

(1928) G. H. H. says: Please inform me at your earliest convenience who was the originator of the horse shoe. A. The feet of horses were protected by leather boots to keep the hoof from splitting and chipping while on long journeys, and by the wealthy people, as early as the times of Aristotle and Pliny These boots were sometimes shod with metal. The mules of Nero were said to be shod with silver. Homer mentions "brazen-footed steeds." Iron shoes nailed to the hoof were first mentioned in the works of the Emperor Leo in the 9th century, and were introduced into England by William 1st, about 1688.

(1929) C. M. H. writes: Is there any chemical that will remove ink from paper without affecting paper? A. Oxalic acid, tartaric acid, or some bleaching agent such as javelle water is generally used for the above purpose. They inevitably affect the paper to some extent. The best plan is to apply them with a camel's hair pencil and to carefully blot off and afterward to wash with water applied repeatedly in small quantity and blotted off with clean blotting paper. Restrict the first application to the ink spot.

(1930) H. J. T. asks: 1. Is there such a thing as a cloth or fabric woven of glass? If so, where is it made? Is said material sufficiently flexible to fit it for practical use? A. Such cloth has been woven from spun glass, but never so as to be much more than a curiosity. It will inevitably be fragile and liable to quickly deteriorate.

(1931) M. S. asks: 1. What chemicals are used for fluxing steel castings in melting? Also what proportion and what irons are used in making soft steel castings? What chemicals, if any, are used in the annealing of steel castings? A. For fluxing steel in the crucible use borax, calcined soda, and pulverized charcoal thoroughly mixed, equal parts. Use scrap cast and wrought iron in proportions which you will have to decide by experiment. With a good clear neutral flame in the annealing oven you will need no chemicals.

(1932) P. E. M. writes: Please inform me what it is that is used on the finger (if anything) in making a musical sound by rubbing the finger tips on top of tumblers or goblets? A. It is sufficient to wet the finger occasionally by immersing the tip in water. Resin may be used, but is not necessary.

(1933) R. F. M. writes: 1. What kind of silk is best for making a small balloon about 3 feet diameter, or is there any kind of cloth that would hold the gas? A. Use thin pongee silk varnished. There is no cloth made that will answer without varnishing. Silk is not necessary. See our SUPPLEMENT, Nos. 249 and 726, for articles on the subject. 2. Will illuminating gas do? A. Yes. 3. Send me the address of some good school where I can get a course of electrical engineering. A. Lehigh University, Bethlehem, Pa.

(1934) L. B. H. asks: 1. What is the most economical appliance for saving the sulphuric acid arising from the burning of copperas, and which can be applied to a furnace at present in use for making rouge? Also the amount of acid which can be saved from one hundred pounds of copperas. A. Condense in a leaden worm. About 67 lb. of acid will be yielded by 100 lb. of copperas. 2. What should the resistance of a telephone receiver be? A. From 100 to 200 ohms. 3. Is it necessary that the coils of single silk-covered wire in a telephone receiver should be paraffined? A. No. 4. Where can I get a description of Edison's carbon telephone, which is used both as receiver and transmitter? Also, is it as good a receiver as Bell's? A. We know of no such instrument in use.

(1935) R. T. R. asks: Can I use manufactured ice in a soda water apparatus? I am told some chemical reaction takes place, which causes the metal pipes to corrode, and burst, perhaps dissolves them. A. You can use it with perfect safety. It will not affect the pipes more than natural ice.

(1936) R. C. R. asks: Why does a tin vessel filled full of water run over when the vessel is compressed or squeezed flat, or otherwise out of its regular shape? In other words, it loses part of its cubic contents when you force its sides together, but the surface area of the inside of the vessel remains the same. A. In general terms, in virtue of a geometrical principle exemplified in the fact that of all figures of equal perimeter, a circle incloses the largest area. It is proved by an elementary proposition not worth producing here.

(1937) E. C. says: I have made a pure copper roller for bleaching sheet cotton; casting was full of holes and porous, and could not be used. Could you inform me how I am to cast this so as to make a good, sound casting? This roller is used for wringing and drying acids out of the cotton. A. It is a very difficult matter to make good, sound castings from pure copper, that will not show a spongy surface when turned off. By adding 5 per cent tin you will make the metal flow free and at lower temperature. The metal should not be boiled, or overheated, which is a cause of sponginess. The manner of pouring should also be arranged by gating down the side for bottom filling, placing the mould at a low angle, so as not to carry air under.

(1938) P. R. A. asks: 1. What is the best way to color a meerschaum pipe, and what is the active agent that produces the color? A. Smoking tobacco in it; the empyreumatic oils absorbed by the meerschaum color it. 2. Is it true that burning a pipe prevents subsequent coloring? A. This will to some extent tend to interfere with the coloring process. 3. What is the process for bringing out and making the color permanent? A. It should be "boiled" or dipped into melted wax, and should be continually polished or rubbed with a silk cloth.

(1939) J. I. asks: Can you tell me what will take ink stains out of a Turkish rug? A. We hesitate to recommend anything, as oxalic acid might injure the rug. Javelle water might answer, but there would be the same risk. Washing with plenty of water, squeezing up with a spoon, followed by blotting, might help.

(1940) S. G. G. asks for explanation of the chemical action of siliceous waters that petrify wood. A. The wood slowly decayed, and the silica by evaporation of the water or change of the temperature or other conditions gradually took its place. No exact account can be given.

(1941) C. H. & A. write: I noticed in an exhibition a man who, upon touching some one of the audience, transmitted to him an electrical shock. I have heard later that this was produced by the party bathing his hands in some kind of liquid. If this be true, can you kindly inform me what is the nature of this liquid? If not, how is the effect brought about? A. The man may have stood upon a metal plate insulated but in contact with an excited electric machine or induction coil. The contact may have been made by a wire or other equivalent means. The general conditions are a fair insulation of the man's person and contact with an excited prime conductor. No such solution as you describe was used, as none exists. The exhibition is a well known one.

(1942) M. J. B. asks: Can the temperature of a refrigerator be reduced by any known chemical process? A. A great many methods of effecting this are known, but they are only applicable to large establishments. You will find a great many artificial ice and refrigerating processes described in our SUPPLEMENT.

(1943) A. B. asks how to soften hard well water containing lime, so that it may be used for sirup. A. If the hardness is due to bicarbonate of lime, boiling or the addition of lime water, with standing, will soften it. If due to sulphate of lime, it cannot be cured.

(1944) O. C. McW. writes for some information as to the process of silvering mirror plates by the nitrate of silver process. A. Various formulas are given. The following is typical: Dissolve 10 grains of nitrate of silver in 1 oz. of water, add excess of strong ammonia, just enough to give a clear solution and to redissolve the brown precipitate which will first form. In another bottle dissolve 10 grains Rochelle salt in 1 oz. of water. To use, pour on the glass two-thirds of the first to one-third of the second solution. The glass may have a little wall of beeswax made around it. A half hour or more in the sunshine or in a warm place at 70° to 80° should give a good silvering. The chemicals must be pure, distilled water should be used, and the glass should be scrupulously clean and polished. After the action has ceased, it should be washed and rubbed gently with a little moist wadding if the outer or exposed surface is to be polished.

(1945) M. F. D. writes: Some time ago I saw directions for reinking a typewriter ribbon without removing it from the machine, by using a glue bottle and sponge, the former containing the ink, the ribbon being reeled from one spool to the other. I have not seen any receipt for making suitable ink for this purpose. Have you ever published such a receipt? A. Use castor oil colored with any desired aniline color previously dissolved in alcohol. If too thick, thin with alcohol. See SCIENTIFIC AMERICAN, vol. 59, No. 21, for an article on this subject.

(1946) B. L. J. asks: 1. How can I prevent printed sheets, such as posters and labels, from sticking together when printed with railroad red printing ink? I have great trouble with the red ink every time I use it. I place the sheets on dry racks, and yet they stick. I have no trouble with any other color but the railroad red. A. Complain to the manufacturer of the ink. Possibly it needs thinning. 2. What kind of ink can I use for inking type writer ribbons, that they will not dry so quick? I use copying ink on Lonsdale muslin, but it soon dries; will not give up the color after 24 or 36 hours. Please state proper way to prepare them. A. See preceding query. 3. Please give me a good receipt for making a good cheap composition for inking rollers for cylinder printing press. A. For ordinarily fast presses on book work, and for general printing, or for inking tablets, use 10½ pounds best glue, 2½ gallons black molasses or honey, 2 ounces Venice turpentine, 12 ounces glycerine. The quantities of glue and molasses should be slightly varied according to the season—a little more glue in summer and a little less in winter. If French glue is used, it should soak overnight to take up the right quantity of water, but most domestic glue will take up sufficient water in about two hours. The turpentine and glycerine should be added and well mixed just before pouring. To make what is known as the black composition, used on high speed newspaper presses, there should be added to the above 1 pound of India rubber, cut in fine shreds, and dissolved in benzine, ether, or bisulphide of carbon, and 4 ounces vinegar. The dissolved rubber should be mixed with the turpentine and added to the composition the last thing before pouring, the glycerine and vinegar being mixed with the glue and molasses a short time earlier. 4. Also how to make liquid glue such as binders use, and how can I color it? A. Dissolve glue in water and mix with it nitric or acetic acid.

(1947) S. R. M. says: 1. I would like a receipt to make a paste to fasten labels to new tin coal oil cans that the oil will not loosen if it should get on label. A. Try gum tragacanth or dextrine. 2. Will the variation caused by temperature in a clock with iron pendulum rod beating seconds be the same as in a clock beating four times one second with same kind of rod? Both clocks supposed to keep good time except the difference caused by temperature alone. A. Theoretically there should be a difference in the temperature variation of plain pendulums of the same material, inversely as their lengths. Thus a half second pendulum is but one-quarter the length of a one second pendulum, its variation in length is but one-quarter as much and its beat is but one-half. Hence there should be less variation in the short pendulum clock from changes of temperature. 3. What is the least percentage of gold that a watch case may contain to be legally called solid gold? A. There is no legal standard for the fineness of gold alloys for watches or jewelry. 4. What does the word carat signify as applied to diamonds and precious stones, and what is the letter used to abbreviate the word carat as used by jewelers? A. Carat only signifies weight as applied to precious stones, and is abbreviated as "C." or Ca. 5. What does the word carat signify as applied to gold, and is the letter K. the proper abbreviation? A. The fineness of gold alloys is expressed in parts of 24 as being pure, called carats. Marked K. from an old custom of spelling it with a K. 6. What is the proper abbreviation used for pennyweight as used by jewelers? Some use dwt., some pwt. A. Dwt. is the correct abbreviation. 7. What is the carat of United States coin gold? What is the metal or metals used to make the coin alloy? A. Standard gold coin is about 22 carats fine, or 900 parts pure gold in 1,000. 8. Is it proper to say zinc is the alloy used with copper to make brass? A. Yes.

(1948) F. B. asks: 1. The size of cores (length and diameter) and size of wire and number of layers to give the best effect in a magnet working from 10 cells gravity battery through 200-250 feet of wire, No. 18. A. Make your cores 4 inches long and ⅝ inch in diameter. Wind them with No. 24 wire, ¾ pound to each leg of the magnet. 2. This magnet is to actuate the hammer for a 16 inch gong, is there enough current? A. The current is sufficient. 3. Should the battery be in series, or two series of five each? A. In series. 4. Also give size of cores and winding for two cells parts motor battery, rated at 2 volts and 10 amperes each. A. Same size cores. The wire on the magnet and the line wire should not be smaller than No. 12. This battery is not adapted to your purpose. 5. Should cells be in series or parallel? A. Series. 6. Will you please name the books (and prices) from which I may learn the rudimentary mathematics of practical electricity? Also a work on storage batteries describing their construction, proper mode of handling, and maintenance. A. We think "Experimental Science" will answer your purpose. See our advertising columns.

(1949) A. A. D. asks: 1. What battery is needed to run a surgical lamp of one-half, one, and two candle power? Is a Leclanche battery of any value in running such lights? A. Three cells of Leclanche will run a lamp of this size for ten or fifteen minutes at a time. 2. Which is the strongest single-celled battery? A. The strongest primary battery in common use is the plunging bichromate. It has an E. M. F. of two volts, and when made very large has very little resistance. The Grove battery has an E. M. F. of over 1·9 volts and a resistance of ⅛ ohm. 3. Has the length of the wires in electric bell work anything to do with the battery, that is, will a Leclanche cell ring a bell at 100 yards distance as well as at 10 yards distance? A. The increase in the length of wire introduced into the circuit increases the resistance of the circuit, necessitating an increase in the number of cells required to work it.

(1950) G. D. H. asks (1) how census appointments are made. A. Address inquiries to Robert J. Porter, Esq., Supt. U. S Census, Washington, D. C., and also apply to the representative of your district. 2. How soon will the maps of 1890 be published? A. It is uncertain. 3. Can a piece of cloth or rubber elastic be woven in strips say 2 feet 12 inches with selvedge sides and ends? A. This can be done by hand on a frame, but not in an ordinary loom. 4. Is there any wire from the size of 5 to 10 that can be used among wet clothes for years without turning them black or soiling them in any shape or manner? If so, has the wire much spring? A. Heavily galvanized steel wire will do this. If the expense is not too great, German silver wire, worth about 50 or 60 cents a pound, might be used. Either kind would be fairly elastic.

(1951) P. C. writes: A friend of mine has his house piped for gas, but has decided to use electric lights, and wanted the company that was to put them in to run the wires through the gas pipe, but the company objected, saying the lights would not burn, and if they would it would not be safe on account of danger from fire. Now I think the lamps would burn all right and there would be no danger from fire if he would connect the gas pipes with the water pipes, by a large copper wire well soldered on. Thus any possible current that might get on to the gas pipe would be distributed over the whole water system of the village, thus giving it such an extensive grounding as to render it harmless. Please tell us who is right. A. It is a common practice here to run wires for incandescent lamps through the pipes of lamp and gas fixtures. We think there could be no danger in arranging the wires as you propose, but it might be objectionable on account of the difficulty of getting at the wires for alteration or repairs. Gas will not burn without the presence of air.

(1952) W. J. asks what is understood by the technical term or word erg, and how applicable in electrical science. A. It is the unit of work and energy in the C. G. S. system of units. It is the amount of work done by a force of one dyne exercised through the space of a centimeter. A dyne is the force which in one second would impart to a gramme an acceleration of motion of one centimeter a second. An erg is equal to 981 gramme-centimeters, or 1,937 grain-feet, or 0·277 foot pounds nearly; 119,133 ergs per minute represent one horse power.

(1953) Echo asks: Please name some of the simplest methods of producing momentum or sustained motion, suitable for working clock without springs or pendulum. A. As motive power, weights, electricity, or even atmospheric changes of temperature and barometer may be used. The opening and shutting of a door may be utilized. As a substitute for a regular pendulum the balance wheel is the only appliance used to a great extent. The conical, the flying, and the torsion pendulums find some application. 2. What other contrivances have been made for keeping time besides sand or hour glasses and sun dials? A. The clepsydra or water clock in many forms, burning candles, the polarization of light clock, observation of the stars, etc. 2. Are hour (sand) glasses made in this country (America) and in any other than the customary form? A. Hour glasses are made abroad. The principal trouble is in procuring proper sand. We cannot give the date you ask for in your letter.

(1954) S. F. J. asks if there is any method of restoring bad-smelling butter to its natural healthy state. A. Success may sometimes follow churning and agitation with lime water. Hemlock twigs and other balsamic leaves may be added also. If the butter is thoroughly bad, there is little chance of making it good again. We are skeptical as to any sure cure.

(1955) J. J. P. asks: 1. Can the disk Leclanche battery be used on closed circuit for any length of time? A. Not more than a few minutes. 2. Can it be used as an accumulator or storage battery? A. No. 3. What make of accumulator is the best and most economical? A. Address the manufacturers for these particulars. 4. Which gives the steadiest current? A. There is little difference in this respect. 5. Is the motive power of the secondary current from an induction coil greater than that from the primary current? A. No.

(1956) S. asks: Is an iceberg fresh or salt, and why? A. It is fresh. Icebergs are fragments of glaciers that descend upon the shores of the Arctic seas and break off from the main mass. They are not frozen salt water. Even if they were, most of the salt would be removed in the process of freezing.

(1957) J. F. asks what time it takes to send a cablegram from New York to Liverpool, provided the line is clear and no connections to be made. A. Three seconds upward.

(1958) Electric writes: 1. Given 10 cells storage battery, E. M. F. 2 volts per cell, internal resistance taken as zero, external resistance at 5 ohms: Find current strength when connected in series and also when connected in multiple arc. A. Connected in series the E. M. F. would be 20 volts; then by Ohms' law $\frac{E}{R}=C$; $\frac{20}{5}=4$ amperes, the strength of the current. When connected in multiple arc, the E. M. F. is 2 volts; then, according to the same law, $\frac{2}{5}=0{\cdot}4$ ampere. 2. Also is multiple arc the same as parallel? A. Yes.

(1959) H. I. H. asks: What will remove the coloring matter of postage stamps, postal cards, etc.? A. An aqueous solution of oxalic acid is a good general reagent for bleaching colored paper.

(1960) E. S. R. asks for the best way of vulcanizing rubber in the manufacture of rubber stamps, and the method employed. A. The gum is mixed with sulphur and is heated in a steam vulcanizer while pressed in the mould. Details of general manipulation of india rubber are given in our SUPPLEMENT, Nos. 249, 251, 252.

(1961) F. J. asks: How are stereotypes made from a printed page without the use of type? A. Such processes are described in our SUPPLEMENT, Nos. 24, 58, 141, 174, 353.

(1962) W. D. C. asks: Can you please give me a recipe for a preparation of phosphorus which, rubbed on any article, will cause it to become phosphorescent? I should like something harmless to the skin. A. Phosphorus dissolved in olive oil may be used, but there is always danger in manipulating phosphorus. Balmain's luminous paint might answer your purposes. It is described in our SUPPLEMENT, No. 229.

(1963) C. E. D. asks: Can you furnish me, through the columns of your paper, with a list of simple inventions which have been the means of bringing fortunes to the inventors? A. We recommend you to consult the "Inventor's Manual, How to Work a Patent to Make it Pay," price $1. On page 33 of this work some information of the character you ask for is given.

(1964) J. H. C. asks: 1. What is the average number of pounds of hard coal that a good steam engine will consume in ten hours, per horse power? A. For a large compound condensing engine 12 to 15 lb., thence up to 40 or 50 lb., according to size and type of engine. 2. What average number of feet of ordinary illuminating gas, per horse power, would run a good gas engine ten hours? A. 250 to 300 cubic feet. 3. Is gas made by consumers from naphtha or gasoline safe? A. It is safe except as regards danger incident to handling and storage of gasoline, always an element of risk. 4. What would it cost per thousand feet? A. This depends on circumstances, and cannot well be stated definitely here. 5. What would material to run an electric motor ten hours cost per horse power, by the storage battery system? A. This cannot be given, as the data are not yet settled definitely. 6. What is the greatest power that it is practicable to obtain this way? A. Any power desired. Your other queries cannot be answered, as circumstances vary.

(1965) A. J. S. asks: 1. How to make or procure something like what is used on slot machines to tell how much current an induction coil produces. A. Place a fine-wound galvanometer on the secondary 2. Give solution for nickel plating some small article, and how to arrange connections to same. A. See our SUPPLEMENT, No. 310, for plating in general and arrangement of connections; nickel solutions have been often given in our columns, such as following: Sulphate of nickel, 1,000 parts; tartrate of ammonia, 725 parts; tannic acid, 5 parts (dissolved in a little ether); water, 20,600 parts; dissolve in 3,000 parts of the water, then add the rest.

(1966) M. B. K. asks: 1. For the proportion in volume of common illuminating gas and common air used in the general run of gas engines? A. One of gas to 10 or 15 of air. 2. Also the force exerted by the explosion of one cubic inch of the mixture? A. The force exerted at the time of explosion may be very great, but is of exceedingly short duration, as the steam soon condenses and the products of explosion rapidly cool. The pressure for an infinitesimal period may run up into hundreds of pounds per square inch. 3. For works containing information as to forces exerted by gunpowder, dynamite, nitro-glycerine? A. We refer you to "The Modern High Explosives," by Eissler, $4.

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(1967) M. B. asks: 1. What is the best solvent for caoutchouc? A. Coal tar naphtha is used; sometimes the solution is effected under pressure. The gum should be masticated first. In our SUPPLEMENT, Nos. 249, 251, 252, you will find the subject discussed. 2. Is painting with red lead and boiled linseed oil the best protection for an iron shaft against rust, the shaft being exposed to action of water? A. It is very good. We would suggest mixing in about one-half best white lead.

(1968) S. S. D. asks for the ingredients used in producing cold chemically. A. One part nitrate of ammonia in two parts of water may be used. All chemical methods are expensive and impracticable except in special cases or on the manufacturing scale. There are many other freezing mixtures. An iron vessel will answer for above.

(1969) J. R. asks: Will crude coal gas, mixed in proper proportion with atmospheric air, be readily exploded by an electric spark? A. Yes.

(1970) Operator writes: I am working a telegraph instrument in one corner of a room about 9 by 13 feet, but am annoyed and hindered by a loud echo caused by the sound of the instrument. How can I overcome this echo? I understand that stretching wires across the room will dissipate the sound. In what direction should they be placed? I forgot to say the walls are about 15 feet high. A. Hang drapery or muslin on the two opposite walls from the machine. If that does not entirely prevent the echo, drape the ceiling also. This can be done in a tasteful manner, so as to ornament the room. The wire work is not sufficient.

(1971) W. F. M. asks: What composition would be best adapted to paint, the inside of a wooden tray, to resist the action of nitrate of silver, used in silvering photographic paper? A. Use paraffin or beeswax melted into the pores of the perfectly dry wood.

(1972) B. D. B. asks for a good receipt for hektograph ink. A. Dissolve 1 oz. aniline blue in 7 oz. hot water. When cool add 1 oz. alcohol, ¼ oz. glycerine, and a few drops of ether and carbolic acid.

(1973) "An Old Subscriber" writes: Who first gave the names ay, ee, eye, yoo to the English vowel letters a, e, i, u, respectively; and when were these names established? Other languages using the Roman alphabet call these letters ah, eh, ee, oo. A. It is undoubtedly due to the Anglo-Saxon race, who, succeeding the Britons, introduced a new language, whose pronunciation excluded the Romance language pronunciation of the vowels. In the old Celtic languages the Continental pronunciation of the vowels obtains. The Britons spoke a form of Celtic whose remains are to be sought in Wales and Cornwall and the Isle of Man.

(1974) I. M. B. asks: How to take ink out of parchment. A. The old manuscript writers used pumice stone. This removes ink from the surface. If it has soaked in, then use a bleaching agent, such as chloride of lime or oxalic acid, blotting off carefully and washing with water, and blotting off repeatedly.

(1975) H. M. C. asks the price of the rare metals. We give quotations, which of course are subject to fluctuations.

Aluminum—(Metallic), per lb.....$2 to	$2.50
Sheet, per lb.	2.50
Arsenic—(Metallic), per lb.	.40
Barium—(Metallic), per gram.	4.00
Bismuth—(Metallic), per lb.	2.75
Cadmium—(Metallic), per lb.	1.00
Calcium—(Metallic), per gram.	10.00
Cerium—(Metallic), per gram.	7.50
Chromium—(Metallic), per gram.	1.00
Cobalt—(Metallic), per lb.	6.00
Didymium—(Metallic), per gram.	9.00
Erbium—(Metallic), per gram.	7.50
Gallium—(Metallic), per gram.	140.00
Glucinum—(Metallic), per gram.	12.00
Indium—(Metallic), per gram.	9.00
Iridium—(Metallic), per oz.	7.00
Lanthanum—(Metallic), per gram.	10.00
Lithium—(Metallic), per gram.	10.00
Magnesium—per lb.	4.50
Manganese—(Metallic), per lb.	1.10
Chem. pure, per oz.	10.00
Molybdenum—(Metallic), per gram.	.50
Niobium—(Metallic), per gram.	5.00
Osmium—(Metallic), per oz.	65.00
Palladium—(Metallic), per oz.	35.00
Platinum—(Metallic), per oz.	9.00
Potassium—(Metallic), per lb.	28.00
Rhodium—(Metallic), per gram.	5.00
Rhuthenium—(Metallic), per gram.	5.50
Rubidium—(Metallic), per gram.	20.00
Selenium—(Metallic), per oz.	1.80
Sodium—(Metallic), per lb.	2.50
Strontium—(Metallic), per grain.	.60
Tantallum—(Metallic), per gram.	9.00
Tellurium—(Metallic), per gram.	1.00
Thallium—(Metallic), per gram.	.25
Titanium—(Metallic), per gram.	2.25
Thorium—(Metallic), per gram.	17.00
Tungsten—(Metallic), per oz.	2.25
Uranium—(Metallic), per gram.	2.00
Vanadium—(Metallic), per gram.	22.00
Yttrium—(Metallic), per gram.	9.00
Zirconium—(Metallic), per oz.	65.00

(1976) J. Y. asks: What is the liquid used to mix with bronze powder in making gold paint? I have used both spirit and alcohol varnish, but they turn the bronze black or a dark color. A. Use japan drier with a small percentage of boiled linseed oil. Both should be fresh.

(1977) A. T. O. writes: I once saw a "chemical sermon." Two colorless fluids being mixed, the result was a black fluid; a red fluid added to this last restored the colorless condition. I am informed that the fluids, in the order used, were a solution of tannin or tannic acid, ferrous sulphate, and bromine. I succeeded in all but the use of the bromine; the black color was discharged, but the result was red. Will you kindly show me the way to success? A. You used too strong solutions. The solution of ferrous sulphate should be very dilute, and so should the tannin. The bromine should be dissolved in water and added to the mixture in just sufficient quantity to effect the decolorization. Use all reagents as dilute as possible.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

February 25, 1890,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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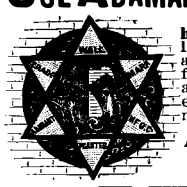

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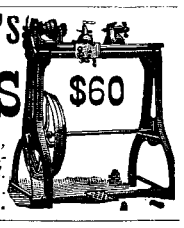

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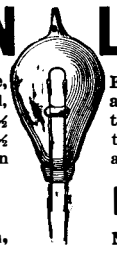

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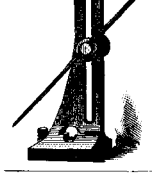

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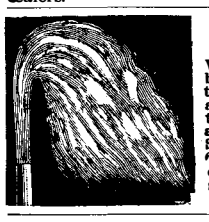

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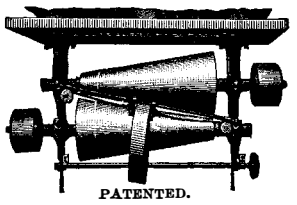

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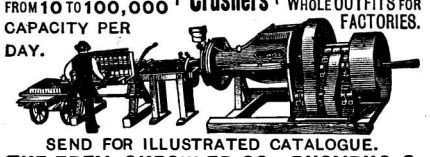

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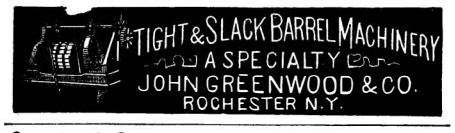

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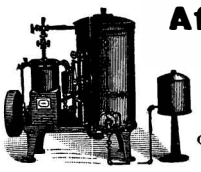

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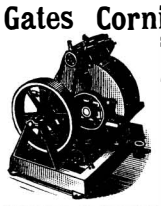

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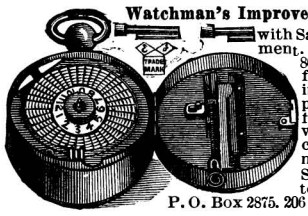

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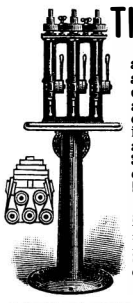

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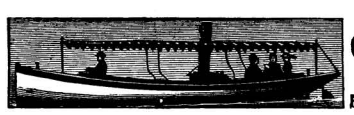

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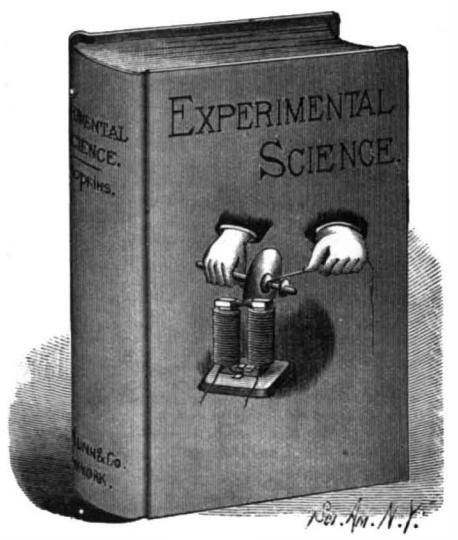

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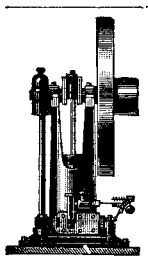

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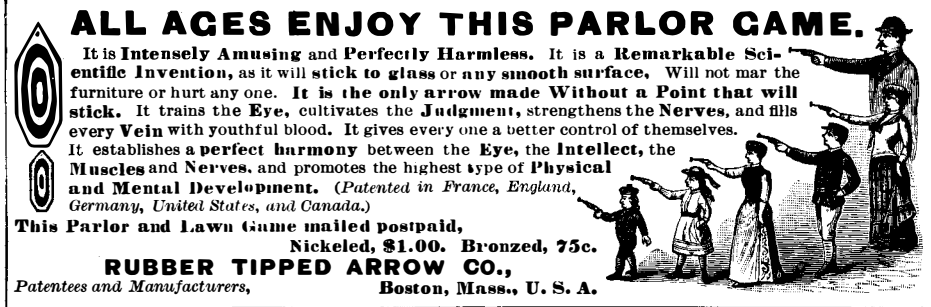

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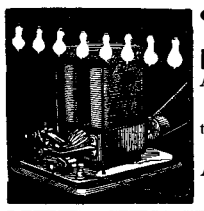

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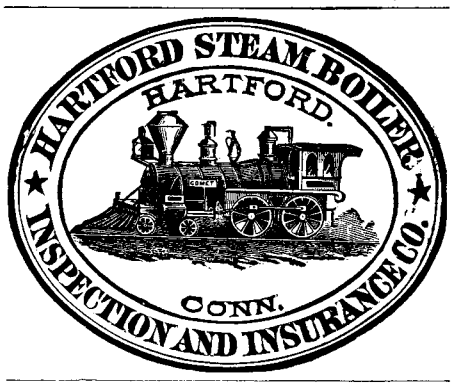

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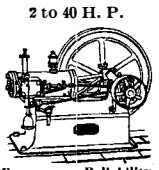

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Interest and Rents in 1889,	286,606.82
Total Receipts during the year,	$1,781,674.35
Paid to Policy Holders and for Expenses, Taxes, etc.,	1,075,871.74
Assets, January 1, 1890,	5,971,506.09
Total Liabilities,	5,049,685.64
Surplus by Vermont, New York, and Massachusetts standard,	$921,820.45
Surplus by Pennsylvania and Maryland standard,	1,256,057.67
18,824 Policies in force, insuring	38,767,541.00
4,744 Policies issued and revived in 1889, insuring	12,743,988.00

The Interest Receipts of this Company have exceeded its Death Losses by more than **$170,000**

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